ESTABLISHING GUIDELINES FOR INCENTIVE/DISINCENTIVE CONTRACTING AT ODOT

Final Report

SPR 630

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by

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16. Abstract

This report describes the results of a research project which explored the use of Incentive / Disincentive (I/D) contracting at the Oregon Department of Transportation (ODOT). The research found that I/D contracting is a relatively rare practice within ODOT. When I/D contracting occurs, the special provisions and parameters (such as setting incentive amounts) are managed on a centralized basis by a small group of individuals. These individuals have used engineering judgment to develop these provisions and parameters in an environment of little historical data. Most of the knowledge of I/D contracting resides with these individuals, and there is little summarized written information that others could use to also develop similar provisions and parameters. Nationally, there is a wide mix in the use of I/D contracting amongst the various departments of transportation (DOTs). FHWA and NCHRP have published reports that compile these experiences and provide recommendations for I/D contracting. This work at the federal level is the basis for the development of an ODOT methodology for identifying project conditions that could lead to the use of I/D contracts. ODOT's Office of Project Delivery uses Operational Notices to document and disseminate operational procedures. A draft I/D Operational Notice is included in this report as a potential tool for implementation of the findings.

Significant in I/D contracting is the establishment of the amount of the incentive (and disincentive). Previously published articles recommend that the incentive be set more than the "lower boundary" of contractor's cost of the acceleration (plus a reasonable profit), but less than the "upper boundary" of the cost of the delay to the public. This latter "upper boundary" value is usually established through the calculation of Road User Costs (RUCs), which calculation is commonly performed by DOTs, including ODOT. The research discovered, however, that there is a lack of working-level techniques to establish the "lower boundary" of the contractor's cost of acceleration plus reasonable profit. This research proposes a method of economic analysis in determining the contractor's costs for acceleration. A model is developed that establishes the "lower boundary" and "upper boundary" parameters based on evaluations of contractors' costs and Road User Cost (RUC) cost techniques. These boundaries in turn provide a range within which incentive amounts would be effective. While the model is demonstrated in Microsoft Excel, the calculation methodology could be performed on a standard form, calculator or a different spread sheet program. The standardization of the process through defined methods and/or program templates provides a formal method and basis for determining effective values for incentives – leading to consistency and auditability.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit	(F-32)/1.8	Celsius	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
m^2	meters squared	1.196	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
ml	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius	1.8C+32	Fahrenheit	°F

*SI is the symbol for the International System of Measurement

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DISCLAIMER

ESTABLISHING GUIDELINES FOR INCENTIVE/DISINCENTIVE CONTRACTING AT ODOT

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1.0 INTRODUCTION

The Oregon Department of Transportation (ODOT) has traditionally procured its major highway work through standard, low-bid procurement, driven largely by legislative mandate and Department of Justice requirements. In this system, the lowest responsive bidder is awarded the contract and is expected to complete the project no later than the time-frame dictated by the bidding documents. In this method, the primary mechanism for ensuring on-time completion is the contractual imposition of liquidated damages if the project is completed late.

Many successful projects have been constructed using this cost-focused procurement system; however, ODOT reports that approximately one-half of its projects are completed later than the originally mandated completion time, suggesting that liquidated damages are only partially effective. To address this issue, especially on projects that are highly time-sensitive (for political, public inconvenience, or other reasons), ODOT has pursued the use of time-focused, alternative procurement and contracting practices. ODOT's use of these alternate contracting practices has occurred concurrently with similar efforts in other states and has been encouraged by the Federal Highway Administration (FHWA), which has played an active role in assembling the collective national experience and in encouraging the development of consistent contracting guidelines.

The time-focused alternative forms of contracting used at ODOT include the following:

- Traditional bidding with an Incentive/Disincentive provision, where ODOT establishes a target completion date, and the contractor is offered a substantial incentive to apply additional resources or innovative techniques to meet or exceed the targeted schedule completion. Failure to complete on time incurs a disincentive cost.

- Cost-plus-time (A+B) bidding with an Incentive/disincentive clause, where a bidder (rather than ODOT) establishes the time of completion. Commonly, this technique is used to achieve on-time or accelerated performance. If the project is late, the contractor suffers a loss (the disincentive) and if completed early, the contractor gains through an incentive.

- Lane rental, where the contractor is charged for those times when an active lane of travel is disrupted – encouraging minimal use of active lanes for construction purposes. Lane rental charges at ODOT have not been used to establish contractual awards, but have been used to minimize public inconvenience during construction. These methods include both flat-rate lane use charges, as well as time-of-day-sensitive charges that increase amounts during periods of heavy highway use.

- Design/build contracting, where a preliminary design is furnished to a contractor that is then charged with completing the design and constructing the project, encouraging both innovation in design and "fast-tracking" of the work to save time.

All of the above techniques are relatively new to ODOT and other DOTs as well. The focus of this research is the use of the Incentive/Disincentive (I/D) style of contracting. I/D contracting has been used on a limited basis within ODOT; the results, however, have been promising. Establishing a better-documented and more systematic method for I/D contract implementation and of establishing the amount of the I/D, will improve this evolving process.

1.1 PURPOSE OF RESEARCH

Incentive/disincentive (I/D) contracting involves a complex web of competing issues and choosing which provisions to include in a construction contract and thus represents a significant challenge. Specific elements such as labor, material, and equipment costs compete with contractor risk and profit margins.

A uniform set of I/D guidelines and a model for implementing I/D contracting at ODOT could benefit the agency in the following ways:

- Expedited project delivery due to the consistent application of I/D provisions;

- Better understanding of how competing interests from both the agency and contractor perspective are reflected in the bid letting process; and

- Adequate consideration of the true cost of delays or expediting projects to contractors and the public.

It is the objective of this research to document a methodology for incentive/disincentive contracting, to provide a framework for an operating procedure, and to improve on existing methods by developing a model to assist in the economic analysis of incentives and disincentives.

1.2 METHODOLOGY

This research project was divided into the following tasks:

- Literature review;
- Inventory of ODOT's I/D contracting experience;
- Determining ODOT process improvement needs;
- Developing criteria and standards for use and application at ODOT;
- Development of an I/D contracting model to calculate effective I/D amounts; and
- Implementation.

These tasks are further outlined below. As the project proceeded, the first three tasks provided insight and some modification of the remaining tasks, under the direction of an ODOT Technical Advisory Committee. This report presents the results of the completion of these tasks.

1.2.1 Literature review

The literature search involved an extensive review of published reports on I/D contracting and processes used by other state transportation agencies. During the initial review, it was discovered that many excellent studies, and resulting reports, were available at the Federal level (through organizations such as AASHTO, NCHRP, TRB, and FHWA) that summarized the various DOTs' current I/D experience. As a result, there was little perceived value in creating another survey of individual DOTs. The results of the literature review are discussed in Section 2.0.

1.2.2 ODOT I/D contracting experience

The current process for inserting I/D language into ODOT construction contracts is documented in Section 3.0. The resulting flow diagram provides a foundation for developing a feedback loop in the project development process that allows for adjustments and enhancements to Incentive/Disincentive contracting at ODOT. The current ODOT process is shown in Figure 3.3. Two projects are summarized. Areas of potential improvements in ODOT's I/D implementation processes are identified.

1.2.3 Developing ODOT criteria and standards – use and application

The research team developed a process flow model that synthesizes data collected during the previous tasks and demonstrates when it is advantageous to use I/D provisions. The model incorporates current technologies from a variety of sources, including guidance from the FHWA. It provides a "what if" analysis to compare various project characteristics for overall success. The overall indicators suggest when it is appropriate to use I/D contracting, and if used, includes direction on procedures to better ensure success. Section 4.0 explains the process model.

1.2.4 Modeling the economic balance of I/D amounts

The research team developed an economic analysis model based on findings from the background research. The model takes into account project cost, time, market conditions, and variations in project type. The economic analysis model can be used to establish appropriate and publicly-auditable I/D amounts. Section 5.0 provides details about the economic analysis of I/D parameters.

1.2.5 Implementation

The research team produced a draft set of I/D guidelines, using a format used for operational notices developed by the ODOT Office of Project Delivery (OPD). The Operational Notice (PD-17) has been further developed by the OPD, but has not yet been formally adopted. It is included as Appendix C.

An Excel-based tool was developed for evaluating incentives, using the concepts of the model developed in Section 5.0. Additional work is needed to refine parameters used in the model for establishing the contractor's cost of acceleration. These products are introduced in Section 6.0.

2.0 LITERATURE REVIEW

2.1 OVERVIEW

The literature review involved an extensive review of published reports on I/D contracting and processes used by state transportation agencies; much of this history has previously been consolidated through federal-level organizations. Sources included academic journals and publications of transportation-related organizations such as the Federal Highway Administration (FHWA) and the National Cooperative Highway Research Program (NCHRP). This review effort is summarized and is also documented in a separate publication produced as a part of this research. (*Sillars and Leray In press*).

The review below begins with a generally chronological explanation of the early history of I/D contracting, starting with discoveries from early studies of contracting methods used outside of the U.S., and closing with the establishment, by the FHWA, of a special experimental "project" by which individual States were allowed to try I/D contracting. Through these initial reviews, key parameters used in I/D contracting were discovered. A discussion of these key parameters follows the chronological background.

2.2 HISTORIC DEVELOPMENT OF I/D CONTRACTING

2.2.1 European study tours

The Office of International Programs of the FHWA has regularly organized teams whose mission is to visit international transportation departments and discover practices that may be beneficially adopted in the U.S. The teams include representatives from the FHWA, the American Association of State Highway Transportation Officials (AASHTO), the Transportation Research Board (TRB), and other organizations. Of the many such studies conducted, at least three study tours have discussed innovative construction procurement and contracting practices in selected European countries and suggest delivery methods applicable to the U.S. highway agencies.

The 1991 European Asphalt Study Tour found that lane rental contracting methods including incentive/disincentive clauses were frequently used in the United Kingdom on critical projects that must be opened at the earliest possible time. The lane rental with the incentive/disincentive concept was only seen as practical if a large degree of certainty existed on the scope of work. If several structures were involved, or if completion depended on completion of an adjoining section by another contractor, the concept was not used. Officials stated that a change order on a lane rental project is essentially a blank check (*FHWA 1991*).

The Contract Administration Techniques for Quality Enhancement Study Tour (CATQEST) (*FHWA 1994*) found that incentive and disincentive clauses were seldom used for exceeding the specified minimum quality level, but some contracts included bonuses for early completion. Incentives (and disincentives) were considered unnecessary since most contracts in the European Union were procured under a best-quality system. The best-quality procurement system relies on selection of contractors based on prior performance metrics gained through historical experience in performing projects with the agency; cost is not an overriding consideration in such a system. In this instance, it is expected that the successful contractor provides its best effort.

In 2004, a team reviewed construction management techniques in Canada and various western European countries. Where incentive/disincentive techniques were used, they were employed primarily to mitigate traffic congestion caused by construction; however, the use of incentives and disincentives were infrequent and quite varied. Incentives for timely completion included making lump-sum payments only at completion of specified portions of work, congestion lane pricing, and somewhat infrequent use of liquidated damages (*FHWA 2005*).

In summary, the European and Canadian tours discovered a variety of reasons for employing contractual incentives and disincentives. These reasons included time, mobility, and quality. However, to the reviewers, these methods appeared to be applied ad hoc, and were used infrequently. The discoveries did, however, cause increased discussion and experimentation with the use of incentives and disincentives on highway projects in the U.S. These follow-on studies were conducted by Task Force A2T51, established by TRB.

2.2.2 TRB Task Force A2T51

In 1988, TRB established the Task Force on Innovative Contracting Practices (A2T51). This task force was created to identify and suggest methods to improve promising innovative contracting practices (*Van Ness 1990*).

One of the areas of study addressed by the task force was the evaluation of the effects incentives/ disincentives have on bidding procedures for transportation projects. It recommended that specifications should include incentive and disincentive provisions to encourage better quality and early completion of critical projects. Another recommendation was that the A+B bidding concept should be considered for wider implementation. (A+B bidding is discussed in Section 2.3 below.) The task force's findings were documented in Transportation Research Circular Number 386, entitled, "Innovative Contracting Practices" (*Transportation Research Board 1991*).

2.2.3 Special Experimental Project No. 14 (SEP 14)

The TRB Task Force A2T51 requested that the FHWA establish a project to evaluate some of the task force's specific recommendations. The FHWA responded with creation of the Special Experimental Project No. 14 (SEP 14). Since SEP 14 began in 1990, several innovative contracting practices have been evaluated. SEP 14 provided the State DOTs with a vehicle for assessing various types of non-traditional contracting methods on Federal-aid highway projects.

Initially, four innovative contracting techniques were proposed, used and evaluated by a number of DOTs. These four techniques were among those showing promise in studies such as those conducted by the TRB Task Force (as documented in Transportation Research Circular No. 386, "Innovative Contracting Practices") and by the 1991 European Asphalt Study Tour report (*Weseman 1995*). The techniques were:

- Cost-plus-time (A+B) bidding [including I/D use],
- Lane rental,
- Design/build contracting, and
- Warranty clauses.

By 1995, after a five-year evaluation period, three of the four experimental techniques originally identified were declared operational (A+B bidding – including I/D use, lane rental, and warranty clauses) and were no longer considered to be experimental in nature. Based on this designation, departments of transportation may use these techniques without FHWA Headquarters approval on Federal aid projects. In 2002, the FHWA published a Final Rule regarding design-build in the Federal Register (*2002*). This rule, promulgated as a result of the legislation authorizing the Transportation Equity Act for the 21st Century (TEA-21), adds design-build as a contracting method for projects receiving Federal aid.

The bidding and contracting technique that is of interest for the purpose of this research is the A+B method because it has been often accompanied by incentive/disincentive provisions, known as A+B+I/D. A+B bidding is discussed below in the section on Selection of Contract Type.

2.2.4 NCHRP guidelines for multi-parameter contracting

NCHRP Project 10-49, Improved Contracting Methods for Highway Construction Projects, was initiated in January 1997 and documented in 2001 in the NCHRP Report 451 – Guidelines for Warranties, Multi-Parameter, and Best Value Contracting (*Anderson and Russell 2001*). The scope of this NCHRP report for multi-parameter bidding was to provide comprehensive guidelines and develop a general approach or methodology to implement a multi-parameter contract method called A+B+I/D+Q. The use of incentive and disincentive (I/D) provisions in A+B contracts was studied in Chapter 3 of Report 451 of the NCHRP program under the name of "Multi-Parameter Bidding and Contracting." The entire report expands the A+B+I/D method through the addition of a quality parameter "Q." [Note: some DOTs, including ODOT, presently use other letters to describe the quality component.] The "Q" parameter was described as a measurable product-related (not management-related) parameter. Criteria for selecting a "Q" parameter were provided in the report.

2.3 FORMS OF CONTRACTS USED WITH I/D

Incentive/disincentive provisions have been used in two different alternative methods of delivery: I/D only and A+B+I/D. Each of these methods is discussed below, and each has been found to be successful in reducing construction time to some degree (*Herbsman and Glagola 1995*). An understanding of both the advantages and disadvantages of each I/D method is important so that the DOT can decide if a particular contracting method can be effectively used on its highway construction projects.

It should be noted that currently in Oregon, administrative procedure requires special approval of the Oregon Department of Justice when use of A+B contracting is proposed. The process required to obtain this approval may add additional time to project development and in some circumstances may create delay of the overall end date. If the determination to use A+B+I/D contracting is made late in the project development process, it may be more prudent to use traditional bidding.

2.3.1 I/D only

The I/D only method of contracting has been under experimentation for a long time. It is the typical low bid method with the inclusion of I/D clauses. The contract time, defined by the DOT, is stated in the bid documents. This is a contracting system in which a contractor is motivated to accelerate the construction after the bid has been awarded. For each day that the contractor finishes the construction ahead of schedule, an incentive fee will be paid. However, an equal disincentive fee will be assessed for each day required to finish beyond the completion date. In most cases the daily incentive and disincentive are equal in dollars. The DOT specifies the time required for critical work and uses this provision for those critical portions of the project where traffic inconvenience and delays should be minimized. This method has been used in numerous occasions by ODOT and other DOTs. While generally successfully used at ODOT (especially for avoiding schedule delay), the literature reports that some other practitioners are not very pleased with past results. These practitioners argue that since the contract time is determined by the DOT, the contract time requirements may not be very accurate and may be determined on the high side; therefore, contractors may be able to easily save some contract time and earn an incentive without making a special effort. Research by Herbsman et al. (*1995*) showed that, under this procurement method, most of the contractors received an incentive fee, and it has been very rare for anyone to pay a disincentive fee.

2.3.2 A+B+I/D

A relatively recent bidding and contracting technique is the cost-plus-time bidding (A+B) method accompanied by the application of incentive/disincentive provisions, indicated herein as A+B+I/D.

This method requires that bidders propose both cost and a time of completion. Both values are used in the low bid determination, but only the cost value is used to determine the base contract amount. Under this method, each bid submitted consists of two parts:

- The cost or "A" component (essentially, the traditional bid for the contract items), which is the dollar amount for all work to be performed under the contract; and

- The time or "B" component, which is the total number of calendar days proposed by the bidder to complete the project (or perhaps a significant portion of the work) (*Weseman 1995*).

The successful bidder is determined by developing an "equivalent" (also known as "*Best Value*" at ODOT) bid value, based on a combination of the cost component and a calculation of the cost of the time. The lowest and best bid (*Best Value*) is determined by the DOT according to the formula shown in Equation (2-1), where *CostPerDay* is commonly the calculated Road User Cost (RUC) or other agreed value. Where I/D provisions are included in the contract, the I/D value should be used as the *CostPerDay* (*s*). The contract selection is then based on the bid price (*A* component) and the number of days provided by the contractor in its bid (*B* component) multiplied by ***CostPerDay***. The *B* component establishes the schedule for the project.

$$BestValue = A + \left[B \times CostPerDay \right] \qquad \textbf{(2-1)}$$

The FHWA recommends that an I/D provision be used with an A+B contract, rather than with straight competitive bidding where contract time is defined by the DOT. The I/D amount must be substantial enough to motivate a contractor to achieve an earlier completion date or discourage a contractor from finishing later than the contract completion date. Without the I/D provision, a contractor has little reason to finish any earlier than the time bid to secure the contract. The winning bidder's schedule for the completion of especially time-sensitive work establishes the contract time upon award of the contract.

For critical projects that have high road user delay impacts, the A+B+I/D bidding method can be an effective technique to significantly reduce these impacts. Under this method, a bidder is motivated in two ways. First, through the inclusion of time in the competitive bidding process, the bidder is encouraged to propose timely completion durations; these durations often are significantly less than the engineer's estimate. In addition, after the award, the contractor is motivated to reduce construction time to earn an additional incentive amount. The possibility that bidders may inflate their durations to earn substantial incentives when the project is awarded can be overcome by stipulating in a contract clause that if the bidder exceeds the engineer's time estimate the bid can be rejected. Of course, since time is used to determine award, excessive time bids would additionally put a bidder at a competitive disadvantage.

2.3.3 Comparison between I/D only and A+B+I/D projects

Table 2.1 provides a comparison of key parameters for I/D only and A+B+I/D contracts. The agency should determine under which project conditions each type of I/ D contracting is most effectively applied. The factor *s* in this comparison is an amount used in bid determination and also represents the I/D, as discussed in the prior section.

Table 2.1: Bidding parameter variance by procurement type

	Incentive/Disincentive Only (I/D Only)	**Cost-plus-time-plus-I/D (A+B+I/D)**
Contract Time	E	B
Contract Amount	A	A
Bid Comparison Amount	A	$A + sB$
Final Contract Amount	$A + s(\Delta E)$	$A + s(\Delta B)$

Note: any adjustments to final amount due to changes are ignored to simplify comparisons.
E = contract time, established by the DOT

As Table 2.1 indicates, there are differences in how these two project types are implemented:

- In both contract types, the actual monetary amount of the contract is the bid cost amount (A). However, a significant difference between the two contract types lies in the method by which a successful bidder is identified. In I/D only contracting, the bid comparison is made based solely on the cost parameter, A, while in A+B+I/D contracts, the bid award considers both cost (A) and time (B) factors.

- Finally, in both cases, the final contract amount is the sum of the base cost plus the earned incentive (or disincentive).

- In I/D only projects, the contract time is established by the DOT (noted here as E), while in A+B+I/D projects, the contract time is established by the contractor (noted here as B).

- I/D only contracting is based on a DOT-developed schedule for completion, while the A+B+I/D form uses a contractor-developed schedule. The contractor is precluded from criticizing the basis of the contract schedule. This concept is frequently referred to as a "contractor-owned" schedule. With I/D only contracting, the contractor may have a claim that the original schedule is poorly prepared and the DOT will have greater control over scheduling changes.

2.3.4 Lane rental

In the United Kingdom, the original form of I/D was the lane rental charge. In this method, the bidder estimates the time needed for lane closure and includes this cost (based on lane rental fees set by the agency) into the bid. The lowest bidder is determined by the lowest bid for the cost of work items, including the cost of lane rental (*Herbsman and Glagola 1995*). [Note: To date, ODOT has not utilized lane rental to determine contract awards, but uses lane rental as a construction management technique to ensure minimization of traffic disruption.] If the contractor overruns the time estimate, an additional rental fee will be deducted, or charged, to the contractor and, if ahead of schedule, an incentive of refunded rental charges is received for work completed early. The main advantage of this method is that it allows the contractor to choose the best work patterns (day, night, weekend, detour, etc.), since rental fees may be time-specific (often on an hourly basis). Lane rental has evolved into a very similar method to A+B+I/D, in which case the incentive/disincentive daily rate is equal to the rental fee rate for lane closure (*Herbsman and Glagola 1995*).

2.4 I/D CONTRACTING IMPLEMENTATION PROCESS

There are two general approaches for implementing I/D contracting in departments of transportation. The first defines, from a portfolio or list of potential projects, which projects are advisable to use for I/D contracting. This method sets strategic direction and planning for the DOT in a more centralized environment. Portfolio effects to consider include the impact of causing a contractor to favor an incentivized project over a non-incentivized project and the potential for multiple incentives to unexpectedly occur in a given period, causing a short-term financial burden to agencies. (*Anderson and Russell 2001*). The second approach, presented in this research report, defines the implementation of I/D contracting on a decentralized project by project basis. This method recognizes the uniqueness of projects and evaluates, for a particular project, its suitability for I/D contracting and development of key contractual parameters.

As I/D contracting is used on more and more projects, feedback obtained from evaluations will improve the contract risk analysis and contract type selection process of this delivery method.

The contract risk analysis and contract type selection process includes:

- The identification of goals and needs for accelerating a project schedule;
- Evaluation of the likelihood of success in applying I/D methods to the project;
- Selection of the type of contract;
- Implementation of a risk management process;
- Determination of key parameters;
- Preparation of specifications;
- Possible State Department of Justice and/or FHWA approval;
- Project development;
- Contractor procurement;
- Contract administration; and
- Evaluation process *(Anderson and Russell 2001)*.

For simplicity, the term "I/D" is used in this research report to encompass both major types of incentive/disincentive contracts. The two types of I/D contracting are termed herein as "I/D only" and "A+B+ I/D" and are distinguished where appropriate.

2.5 EVALUATING THE NEED FOR USING I/D METHODS

The first major step of the I/D contracting process is to identify the external need and motivation for timely or accelerated delivery of a certain project or portion of a project. The determination of utilizing I/Ds for a particular project should occur during the earliest phases of project development. In this manner, the adequate allocation of resources to design and coordinate the project may be better planned.

Five potential objectives that ODOT should consider when deciding if a project needs to be accelerated are summarized below from the NCHRP Guidelines for Warranty, Multi-Parameter, and Best Value Contracting (*2001*):

1. Shorten Project Duration: The number one reason to implement I/D contracting is to reduce the time it takes to complete the construction of highway projects beyond what has historically been achieved with traditional highway contracting;

2. Reduce Inconvenience to the Traveling Public: Shortened project durations translate into reduced levels of inconvenience to road users, minimized congestion, and less rerouting of traffic;

3. Lessen Potential Impact on Local Businesses and Communities: Shortened project durations reduce the time that business access is potentially disturbed;

4. Encourage Innovative Construction Processes: Innovative construction processes and methods are sometimes needed to accelerate the project. The contractor could also be innovative with the sequencing of construction in relation to traffic throughout the duration of the project; and

5. Improved Perception of Construction by the Public: The use of I/D provisions will decrease the time required for construction. This means that the traveling public will observe that progress is made on a consistent and continuing basis. Agencies have been subjected to public criticism because of what appears to be long time periods where contractors are not seen working on the project consistently.

The majority of projects that use I/D provisions are completed on time or ahead of schedule, which supports the use of I/D provisions (*Arditi, et al. 1997*). However, savings in contract durations are often accompanied by increased project costs when compared to projects without I/D provisions.

Clearly identifying the objectives the agency desires to achieve through the alternative contracting process achieves two goals: first, the use of the contracting process is more easily and readily defended under conditions of public criticism, and second, a baseline is developed for evaluation of the success of the project (and other projects) (*Anderson and Russell 2001*).

2.6 I/D PROJECT SUCCESS CRITERIA

After the need for using the I/D contracting method has been established, the next major step of the I/D contracting process is to evaluate if the project itself meets the criteria for successful implementation as an I/D project. One of the greatest challenges involved with the implementation of an I/D contracting process is determining which projects are most effectively administered with an I/D contract. The criteria below must also support any ODOT objectives that may apply, such as administrative regulations for alternative contracting (legal review, etc.) or budget constraints.

FHWA Technical Advisory T5080.10 recommends that I/D provisions should not be used routinely, but only for completion of projects or portions of projects for which one or more pre-selected criteria exist (*FHWA 1989*). Several sources have developed criteria for evaluating whether a project is a candidate for the use of I/D contracting techniques (*Anderson and Russell 2001*; *FHWA 1989*; *Utah Local Technical Assistance Program (LTAP) 2005*). These lists contain many similarities, yet each provides unique perspective as well; a consolidation follows:

Public Inconvenience

1. Where high-traffic volumes exist, typically in urban areas;

2. Where traffic restrictions, lane closures, or detours result in high road user costs (RUC);

3. Major reconstruction or rehabilitation on an existing facility will severely disrupt traffic;

4. Lengthy detours of high traffic volumes;

Constructability

5. A contractor's expertise is needed to facilitate an earlier completion;

6. The I/D phase(s) can be completed in one construction season or less;

7. Traffic control phasing can be structured to maximize a contractor's ability to reduce the duration of construction;

8. The project is relatively free of utility conflicts, design uncertainties, or right-of-way issues which may impact the bid letting date or the critical project schedule;

9. Availability of contractors with sufficient resources;

Public Safety

10. Safety concerns during construction, including impacts to public, pedestrian, and/or worker safety;

11. Disruption of emergency services;

12. Emergency response to an unexpected loss of highway facility;

Public Priority

13. Project completion by a specific date is in the public's interest;

14. Adjacent neighborhoods or businesses would suffer a significant impact;

15. Project will complete a gap in the highway system;

16. Major bridges will be out of service;

17. Completion time constraint;

18. Interference with major public events; and

19. Highly sensitive project due to businesses impacted or political issues.

The relative importance of the criteria needs to be determined in order to make a decision. The criteria could be weighted to reflect level of importance, perhaps by survey or expert panel. Lacking a set of standardized guidelines, the DOT should determine the relative importance of these and other criteria for each project. A DOT may also require that the project meet or exceed a certain RUC value in order to use I/D contracting. Some agencies specify a minimum threshold RUC level such as $2,000 - $3,000 per day (*Utah Local Technical Assistance Program (LTAP) 2005*)

A DOT must determine how to use the criteria to make a decision as to whether the project is a good candidate for I/D contracting. The following are some possible decision rules described by the FHWA (*1989*) :

- "Require the project to meet all criteria;
- Require the project to meet the top three criteria;
- Require the project to meet a minimum RUC and three of the other criteria; and
- Require the project to meet a minimum RUC, have utilities and ROW cleared, and two of the other criteria."

Not every project is right for the use of I/D contracting. The DOT should select projects that will maximize the chances for successful completion using I/D. A comparison must be made between the information gathered on the project characteristics and the objectives established previously. If it is evident from the information gathered that the objectives established are attainable using I/D contracting, the DOT should continue pursuing the selected I/D method. If the objectives appear unrealistic, the DOT should stop the implementation of the selected I/D method for this project and choose another contracting method (*Anderson and Russell 2001*).

2.7 INCENTIVE/DISINCENTIVE PARAMETERS

Once the agency has determined the motivation for using I/D contracting or what they want to achieve through the use of I/D in the project, key contractual parameters must be determined. These include the determination of road user costs (RUCs), I/D amount, I/D caps, maximum time allowed and minimum time allowed for the incentivized portion. Due to the infrequent use of I/D contracting methods and a lack of formally defined methodologies, strong engineering judgment, coupled with well-kept historical data become important factors in developing effective I/D parameters.

2.7.1 Incentive/Disincentive time

The incentive/disincentive time was defined in the 1989 Technical Advisory document as "the time (calendar days or completion date) established for the contractor to complete critical work on identified roadway(s) and/or structure(s)." [Note: Identified roadways, segments of roadways or structures, or phases of a project are herein referred to as "portions."] As previously explained in the section related to types of contract, the party defining the I/D time would vary depending on whether it is an I/D only or A+B+I/D contract. If it is an I/D only contract, the DOT defines the I/D time and if it is an A+B+I/D contract, it is the contractor who defines the time (*FHWA 1989*).

A thorough analysis of the construction schedule is required to determine I/D time. The key to successful implementation of I/D time is an accurate evaluation of the time required to complete the incentivized portion, based on regular work hours and normal efficiencies (*Shr and Chen 2004*). Underestimates of time may cause unreasonably high bid prices and unattainable acceleration. Overestimates of time set by the DOT may allow the contractor to earn the maximum amount without making an increased effort. This would also penalize the public since the I/D phase(s) may not be completed as soon as possible but will cost more due to the incentive payment (*FHWA 2005*).

Normal construction time is generally based on a competent contractor working five days a week, eight hours a day, while an accelerated time should be based on the performance of a good contractor working extended or extra shifts with additional workers for six or seven days a week. Standard production rates, estimated hours to be worked, engineering judgment, and experience can be used to determine the accelerated schedule. Continuous seven-day workweeks should be avoided, since extended periods of work without days off can result in high turnover rates for contractor and inspection personnel.

In addition, maximum and minimum project durations may be defined. Typically, the maximum allowable duration is specified for the project. A few agencies also specify minimum project durations. Scheduling tools such as the critical path method (CPM) can be used by the agency to adjust for accelerated production rates to arrive at an estimated shortened schedule. By establishing a minimum project (or portion) duration, the agency may avoid the receipt of bids wherein the bidder strategically proposes a high construction cost, but also proposes an unrealistically short construction time in order to secure the bid. Contractors should be required to submit a CPM (critical path method) schedule with their bid (*Anderson and Russell 2001*).

In an A+B+I/D contract, where the I/D time is considered when awarding the contract (the time required to complete the incentivized portion), the I/D time bid would be determined by the competitive environment and would reflect the most likely duration for the project as seen from the perspective of the contractors.

The use of calendar days or completion date (rather than working days) has been shown to be an effective contract parameter. Working days are subject to interpretation and the incentive increases the pressure for non-working days to be declared by the project engineer. This leads to an increased adversarial relationship among the parties during the construction phase (*FHWA 2005*).

The FHWA recommends that the season of the year in which the project will be constructed should also be considered in determining the I/D time for calendar day projects. The project should be such that an I/D portion can be completed in one construction season. Weather days and legal holidays should be included for calendar day projects.

2.7.1.1 Total project I/D time

A total project incentive/disincentive contract assumes that the I/D amount is based on the schedule of the entire project. This incentive type should be used only when the entire project is causing impact to traffic during the full duration of the project; otherwise, the contractor may shorten a non-impact portion of the project and gain rewards without substantial benefit to the public.

2.7.1.2 Segmentally applied I/D time

Using segmental I/Ds, the I/D amount and I/D time are defined for only certain portions of the project that are causing impact to traffic or are critical to timely completion.

Examples may include a bridge in a larger project, a roadway segment that is particularly congested, an interchange, etc.

2.7.2 Incentive/disincentive amount

It is very important to determine the appropriate dollar amount per day for I/D provisions for early completion of projects. To be effective and accomplish the objectives of I/D provisions, FHWA Technical Advisory T5080.10 recommends that the dollar amount be of sufficient benefit to the contractor to encourage his/her interest, stimulate innovative ideas, and increase the profitability of meeting tight schedules (*FHWA 1989*). If the incentive payment is not sufficient to cover the contractor's cost for the extra work (additional crews, overtime, additional equipment, etc.), then there is little incentive to accelerate production, and the I/D provisions will not produce the intended results. The manner in which the I/D amount is determined and documented is very important to the contracting agency in case it becomes involved in a legal dispute with the contractor (*Jaraiedi, et al. 1995*).

According to the Technical Advisory, a daily I/D amount should be calculated for a particular project based on:

- "Established construction engineering inspection costs;
- State related traffic control and maintenance costs;
- Detour costs; and
- Road User Costs."

Costs attributed to disruption of adjacent businesses should not be included in the daily I/D amount.

The value of the Road User Cost (RUC) is predetermined by the contracting agency and, if it becomes the basis of the I/D or is used for determination of the "B" portion of the bid, it is specified in the proposal. Most agencies have a standard method for estimating RUC on traditional projects. If none exists, a method for determining RUC should be developed. The agency should decide how much of the estimated RUC will be included in the contract for the time-related costs. For incentives, agencies have used anywhere from 10 percent of the estimated RUC to the entire amount of RUC in previous A+B+I/D contracts. Engineering judgment or agency policy usually determines what percentage of the estimated RUC is used.

Engineering judgment may be used to adjust the calculated daily amount downward (not upward) to a final daily I/D amount that:

- "Provides a favorable benefit/cost ratio to the traveling public where the cost is the daily I/D amount and the benefit is the calculated daily savings in road user and State Highway Agency costs; and

- Is large enough to motivate the contractor. If a favorable benefit/cost ratio cannot be realized and/or the resulting daily amount is not high enough to motivate a contractor, the project should not be further developed as an I/D project" (*FHWA 1989*).

The total incentive amount is calculated by multiplying the number of days that the contract is completed earlier than the contractor's bid time (B) by the established I/D amount for the contract.

The 1989 FHWA Technical Advisory proposes that the disincentive daily rate should equal the incentive daily rate. If different rates are selected, the incentive daily rate should not exceed the disincentive daily rate (*FHWA 1989*). A cap of five percent of the total contract amount is recommended as the maximum incentive payment. The Technical Advisory indicated that the five percent was based on a National Experimental and Evaluation Program (NEEP) study of average incentive payments made on experimental I/D projects. The placement of a cap on the incentive payment limits the funding requirements that may result if the time analysis is not realistic for an accelerated project time. With experience, the agency may feel comfortable in not setting any maximum on the number of days for which an incentive can be earned. Frequently, the incentive is capped by the agency at a maximum percentage of the contract amount, a set maximum dollar amount, or a set number of days that will be paid for early completion. According to the FHWA Technical Advisory, a cap should not be placed on the maximum disincentive amount, although some agencies cap both the incentive and disincentive equally (*Anderson and Russell 2001*). Overestimation of the maximum incentive may waste public money while underestimation will reduce the effectiveness of the incentive to motivate the contractor (*Shr and Chen 2004*).

2.8 ECONOMIC ANALYSIS OF I/D PROVISIONS

2.8.1 Methods of establishing incentive amounts

There have been a few papers written on the subject of determining values for incentives and disincentives in highway construction projects *(Anderson and Russell 2001; Arditi, et al. 1997; Brown 1997; FHWA 1989; Shr, et al. 2004; Transportation Research Board 1991*). These papers generally describe either of two methodologies used to create a rational means for establishing appropriate unit values for incentives. These are Road User Costs and an analysis of the cost of time changes to the contractor, using global bid result information.

Road User Costs (RUCs) have been used as the basis for determining I/Ds, as reported by several authors (*Herbsman, et al. 1995; Jaraiedi, et al. 1995; Shr and Chen 2004*). This method has been used by many DOTs in the U.S. However, it is noted that increasing population and urbanization have brought substantially higher traffic volumes, yet the number of highway miles has not increased proportionately. The effect is increased congestion and therefore increased RUCs for a given segment of highway. If RUCs continue to be the basis for I/Ds, then the I/D amount will become substantially more than required to adequately reward the contractor for accelerating the work. Other methods for establishing I/Ds, which better reflect the contractor's project economics, should be developed.

Various methods have been reported that attempt to tie the I/D amounts to project economics. One such method used by the New Jersey DOT and others involves establishing a schedule of daily I/D fees based on total project value as shown in Table 2.2 (*Herbsman, et al. 1995*). Variations of this total project cost-based approach, used in other agencies, include the initial use of road user cost to establish the I/D, but with specific caps on the total amount, varying from 5 to 10 percent of total project cost. Further, Shr (*2004*) used historic bidding data obtained from the Florida Department of Transportation to establish a formulaic method to determine reasonable I/Ds, again based on the total project cost.

Table 2.2: Schedule of daily I/D fees (NJ DOT) (*Herbsman, et al. 1995*)

Total project cost ($MM)	Daily I/D Rate ($)
0-0.5	1,000
0.5-1.5	2,000
1.5-5.0	5,000
5.0-10.0	6,000
10.0-15.0	8,000
15.0-20.0	10,000
20.0-30.0	13,000
30.0-40.0	16,000
40.0-50.0	17,000
50.0+	0.3% of TPC

The total-cost approach is limited due to the fact that most I/Ds are developed to accelerate only portions of a particular project. Since the individual portions of the project affected may involve particularly difficult work, the potential impact of increased risk to the contractor should be taken into consideration. Development of a method that takes into account the specifics of the accelerated portion would address these concerns.

2.8.2 The basic I/D equation

A balance must be struck in choosing an appropriate I/D between Road User Costs (RUCs) and the cost of acceleration to the contractor (*Herbsman, et al. 1995*). Equation (2-2) indicates that an appropriate I/D amount should meet two conditions. First, the I/D amount needs to be greater than or equal to the contractor's cost of accelerating the work (CA), referred to as the lower boundary. The I/D amount generally should be greater than CA; otherwise the I/D only reimburses the contractor for its costs, and there is no real incentive to accelerate, since the contractor would gain no additional profit whether meeting or beating the contracted time. Second, the I/D amount must be less than or equal to the RUC created by the construction process, referred to as the upper boundary. If an I/D amount exceeded the RUC, then the public would be in a position of loss – not justifiable on a public cost-benefit basis.

$$CA \le I / D \le RUC \qquad \textbf{(2-2)}$$

Most DOTs have well-developed and quite often very sophisticated methods for determining the Road User Costs. However, no standardized means to determine the CA was discovered in the literature. Individual contractors regularly determine this value for their firms, but that information isn't available to ODOT. A simple method that ODOT could use to develop a reasonable estimate when setting incentives would be helpful, especially prior to establishing a construction contract.

2.9 SUMMARY

Incentive/Disincentive contracting has been used with increasing frequency over the past three or four decades both in the United States and abroad. However, use of I/D contracting has been rather "experimental," using a variety of different parameters on a variety of different projects. Its use is still relatively infrequent when compared to the use of the more traditional "hard-bid" contracting method utilizing liquidated damages as the primary means of contractually enforcing completion times.

FHWA and the NCHRP have gathered much of the national experiences and summarized those experiences into draft guidance. This guidance is well-crafted and should be utilized at ODOT for its I/D contracting process. What is less well-understood, however, is the calculation and evaluation of the amount of the I/D itself. Although some basic equations for this evaluation have been proposed, more work must be undertaken to develop a rational and effective method for establishing I/D amounts.

3.0 ODOT I/D CONTRACTING EXPERIENCE

3.1 OVERVIEW

ODOT's experience with incentive/disincentive contracting is limited and is not well documented. For the most part, a few individuals have used their experience and judgment to develop the I/D projects on an ad hoc basis. This has worked satisfactorily in an environment of infrequent use of I/D methods. However, the development and use of standardized methods will encourage wider and more effective use of I/D methods within ODOT. Additionally other DOTs will to benefit from the lessons learned at ODOT.

3.2 ODOT PROJECT EXPERIENCE USING I/D CONTRACTING

As shown in Figure 3.1, ODOT has used I/D contracting methods on a number of projects.

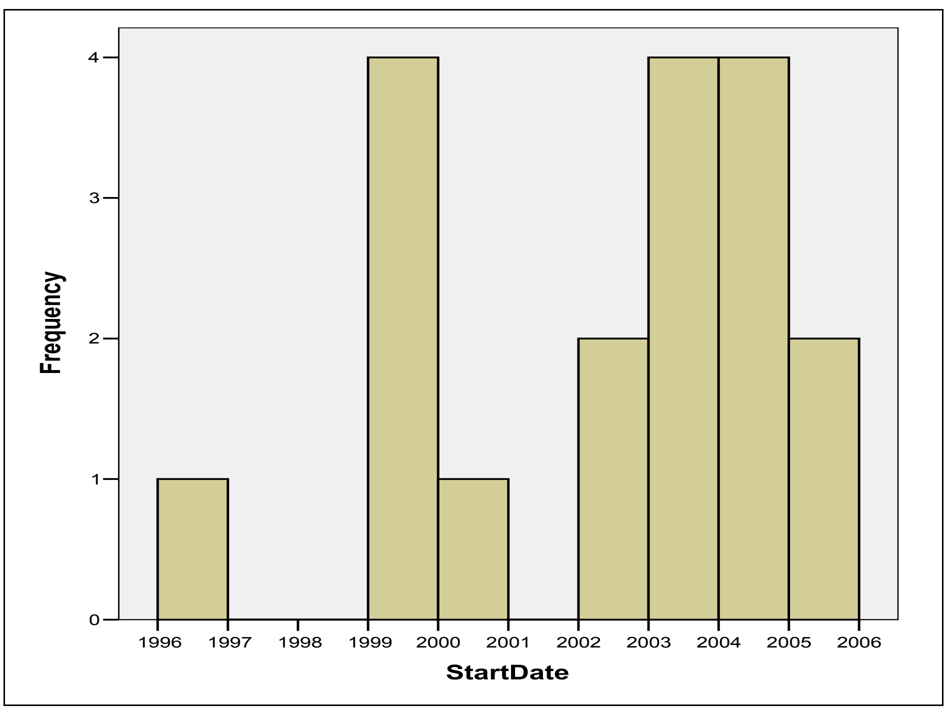

Figure 3.1: Frequency of ODOT I/D projects

Table 3.1 presents summarized information on 18 projects where I/D contracting has been used. Information was obtained largely from project records and personal recollection. It was found that each project's development of I/D parameters was unique; no "standard" methodology was practiced across the board, and there was no centralized documentation of the facts surrounding success or failure of the incentive process for the purpose of improving the process agency-wide.

Table 3.1: ODOT I/D projects

I/D project	Start Date	Approx. Value
Interstate Bridge Trunnion Repair	1996	$2.9 M
Sand Lake Road Slide	1999	$1.5 M
Spencer Creek Detour Bridge	1999	$1.8 M
Evans Creek Section / I-5	1999	$7.7 M
Kruse Way I-5/ Hwy 217	1999	$34.3 M
Garden Valley Blvd.-Roberts Creek	2000	$12.4 M
Medford Viaduct Section /I-5	2002	$6.3 M
St. Johns Bridge Rehabilitation	2002	$31.0 M
Trout Creek Bridge Section	2003	$0.3 M
Columbia River Br. - Willamette River Br. (Unit 1) Sec./ I-205	2003	$14.8 M
I-84 Quarry Bridges	2003	$18.7 M
I-5 McKenzie and Willamette Bridges	2003	$28.9 M
OR 47 Azalea St. - 2nd St.	2004	$0.9 M
Mt Hood to Chemult Bridges	2004	$30.5 M
US 101 Cape Creek Tunnel Section	2004	$5.0 M
Chemawa Rd. - N. Santiam Interchange	2004	$5.8 M
I-105: Willamette River-Pacific Highway	2005	$13.0 M
I-5: N. Santiam – Kuebler Blvd.	2005	$65.2 M

ODOT's use of I/D projects began in 1996 and has occurred sporadically since that time, with up to four I/D projects per year, varying dramatically in size over the years from a low of $300,000 to a high of $65,200,000 – averaging approximately $15,600,000. Figure 3.2 presents historical information on the size of projects that have used I/D contracting. Figures 3.1 and 3.2 show that I/D contracting remains a relatively rare event at ODOT. The effect is that the creation of specifications and values for I/Ds have been traditionally handled by a few personnel. While historically this has produced many successful projects, as the use of I/D techniques increases, more individuals will need to become involved, and there will be need for better documentation and more consistent techniques. Appendix A contains additional details about ODOT's I/D projects. Appendix B contains a listing of specifications from the projects, where available.

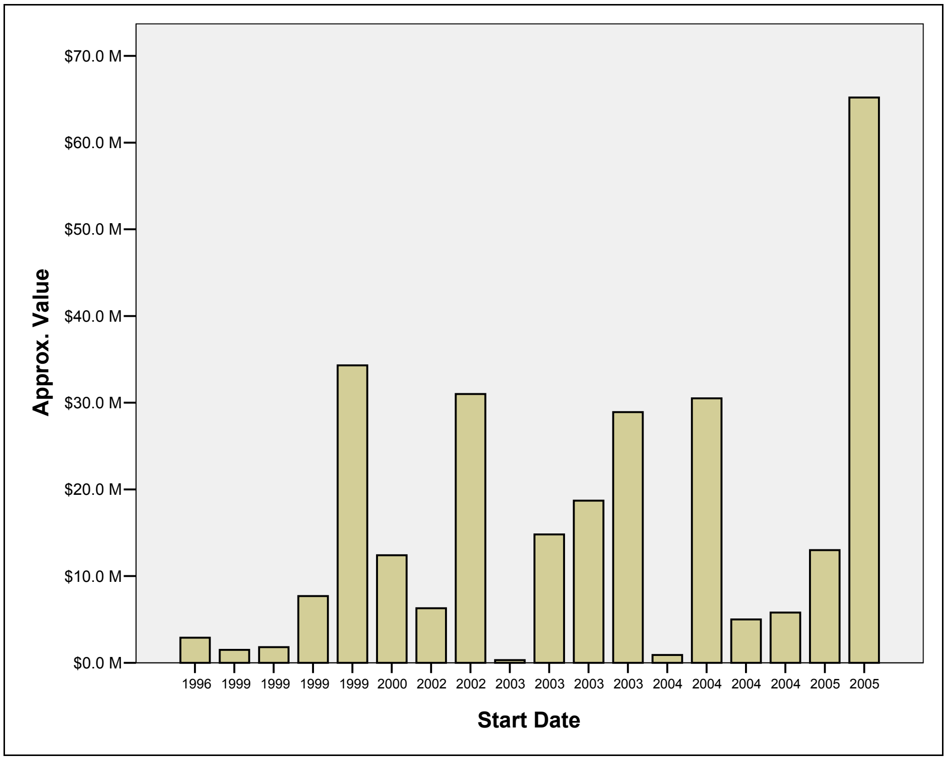

Figure 3.2: ODOT I/D project sizes by date

Interviews with ODOT personnel indicated that two of the completed ODOT I/D projects – the Interstate Bridge Trunnion Repair project (reportedly the first ODOT project to use I/D provisions) and the Kruse Way project (a complex, politically sensitive project) – were especially important in forming opinions about the use of I/D contracting.

3.2.1 Interstate Bridge Trunnion Repair

The Interstate Bridge Trunnion Repair project was a lift span repair of a bridge on the northbound lanes of I-5 over the Columbia River in 1996. Since this bridge is a key passage between the states of Oregon and Washington, there was considerable need to reduce the amount of time that the bridge would be closed to traffic due to the rehabilitation construction. The Road User Cost of closing the I-5 northbound bridge and rerouting the traffic was estimated to be in excess of $100,000 per day. The work was technically challenging, and to ensure success, ODOT bid the contract using a best-value process in which selection was based on both technical and cost proposals. The contract encouraged innovation by offering a $100,000 per day incentive; additionally, a $100,000 per day disincentive loomed over the successful bidder if the bridge closure went beyond 21 days. Many contractors did not submit bids for this reason. The successful bidder, Christie Constructors, offered a bid of $2.87 million – one of five bids submitted from around the nation to repair the 80-year-old bridge.

As the project began, ODOT added an additional incentive/disincentive that was not originally part of the project. The incentive/disincentive was added at a rate of $4,000 per hour. At its own expense, Christie developed an accelerated repair method that reduced the anticipated bridge closure by two weeks. The effort netted the Richmond, California corporation an approximate $1.4 million incentive bonus, increasing the total contract work to $4.3 million. Reportedly, the quality of the finished Interstate Bridge Trunnion Repair work is exemplary.

The Interstate Bridge Trunnion Repair project is an early example of a well-defined project with an I/D amount that encouraged innovation in construction execution. The impact of the traffic closure was significant, both in terms of Road User Costs as well as in political terms. Incentives were set at the highest reasonable bounds, reflecting the significant importance. The result was a success that set the tone for future I/D efforts at ODOT.

3.2.2 Kruse Way

The Kruse Way project was let in 1999. It was a modernization of the interchange at I-5 and Hwy 217 near Lake Oswego, south of Portland. Oregon Highway 217 provides the only freeway access from the south to the western Portland metropolitan area, creating political focus on the project. The interchange was already experiencing significant peak hour congestion and traffic flow problems. Daily Road User Costs for construction delay were estimated at $10,000 per day. As a result, the decision was made to offer an I/D and thereby create focus on timely completion.

An A+B form of bidding (see discussion of A+B contracting, above) was used to solicit contractors for the extensive work. The construction contract offered for bid included a $10,000 per day incentive for early completion or a $10,000 per day penalty for late completion. The low bidder on the project was Kiewit Pacific Co. with a bid of $34.3 million and a commitment to build the project in 475 days. This aggressive schedule was considerably under the ODOT time estimate and required much of the work to occur simultaneously.

The contractor completed the work 56 days ahead of schedule. This qualified the contractor for a $560,000 early completion incentive payment. Unanticipated work primarily involving wet subsoil added some costs and time to the work schedule, and this complicated the administration of the I/D portion of the project.

The Kruse Way project successfully encouraged the contractor to remain focused on accelerated completion of the work. However, balancing changes created by unexpected project site conditions with the focus on accelerated delivery created unexpected work loads and challenging negotiations for the ODOT project staff. This project demonstrated the value of thorough pre-project site analysis and possibly increasing ODOT construction staff on I/D projects that may incur unexpected site changes.

3.3 ODOT I/D CONTRACTING PROCESS

The current process for inserting I/D language into ODOT construction contracts was documented from interviews with ODOT personnel. Figure 3.3, which is based on these interviews, provides a generalized flow-chart of principal steps and processes used to implement I/D contracts. While the process not been standardized, Figure 3.3 provides a foundation for development of I/D projects that will be adjusted and enhanced as ODOT gains more experience with incentive/disincentive contracting. The process of establishing an I/D project may actually begin at any stage in project development, from Project Initiation through the start of Construction.

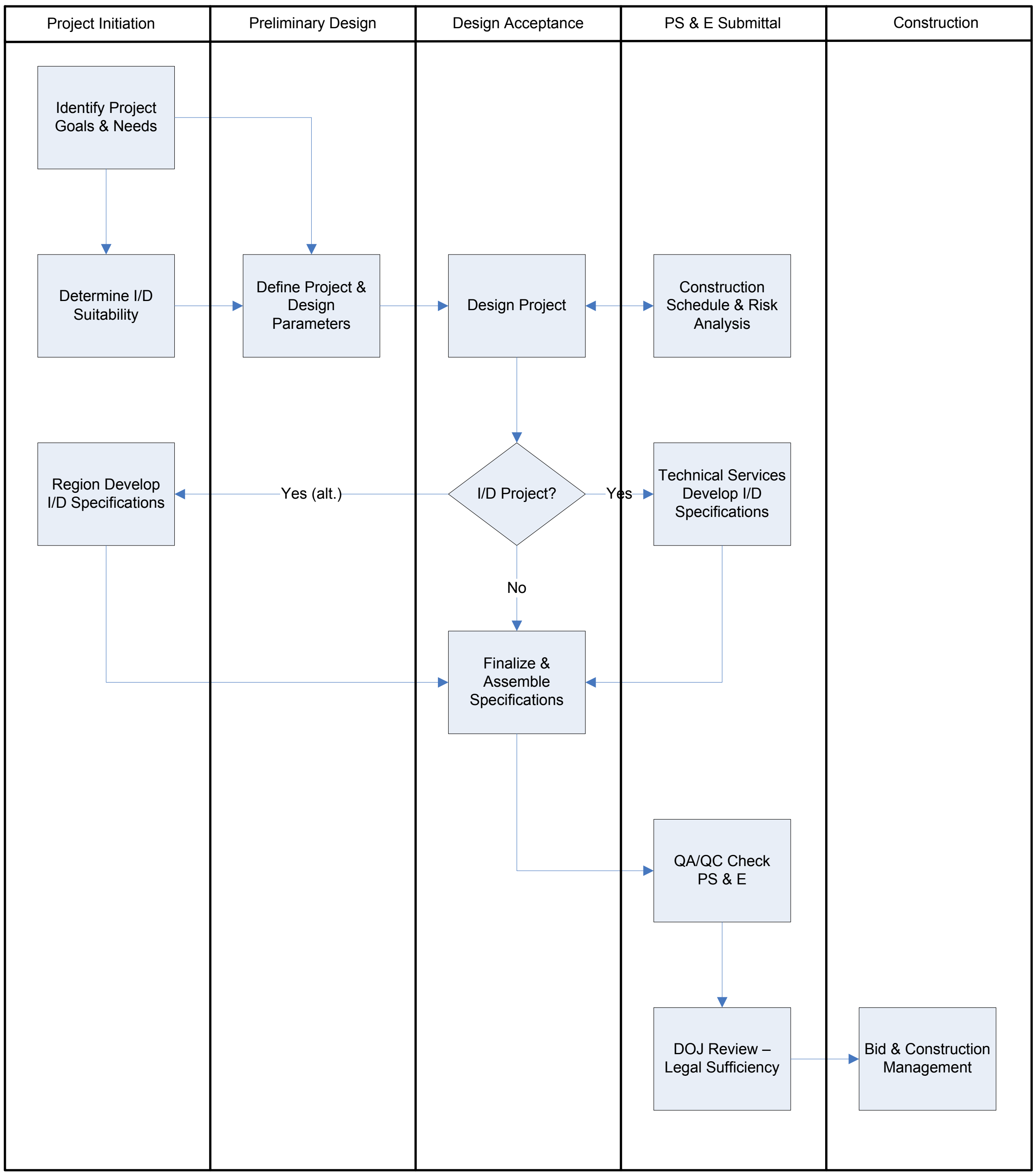

Figure 3.3: ODOT I/D implementation process

ODOT processes for handling the decisions about determining what kinds of contracting to use and for establishing key contractual parameters and language are changing. The relatively infrequent use of I/D contracts has meant that a few individuals in the ODOT Office of Pre-letting have determined whether I/D contracting will be used. This informal "centralization" is expected to change. As more I/D projects are implemented, the increased volume will require more distribution of the work. Figure 3.3 shows that I/D contracting decisions are envisioned to be made jointly by area managers and centrally-located personnel.

Decentralization, in general, may incur benefits such as increased efficiency and better consideration of local factors during early project definition. However, decentralization could carry with it loss of organizational history of contracting methods, since this function was originally carried out by a small number of individuals. Additionally, decentralization may allow a lack of consistency to creep into project contract development. The purpose of this research is to aid in developing consistency and in capturing lessons learned that can be used by a large number of managers.

3.4 I/D CONTRACT SPECIFICATIONS

Sample specifications of past ODOT projects appear in Appendix B. A significant amount of customization has occurred in developing I/D specifications for specific projects; yet there are common patterns that exist across the specification sections listed.

A brief "boilerplate" of typical specification clauses, with generic paragraph numbers, is outlined below. The reader is encouraged to explore the sample specifications included in Appendix B to extract language that may be specifically applied to a particular project.

> SECTION XXXXX – INCENTIVES FOR EARLY COMPLETION
>
> Section XXXXX, which is not a Standard Specification, is included in this Project by Special Provision.
>
> XXXXX.XX Scope – (This section should include a description of the scope of the project that is to be accelerated with the use of an incentive award for early completion).
>
> XXXXX.XX Incentive Award – The amount of the incentive award will be $XXXXX per Calendar Day, up to a maximum of XX Calendar Days, counted from the actual date of completion prior to (month day, year). Any partial day will be rounded to the next nearest whole day. The maximum incentive award to be paid under the Contract will not exceed $XXXXXX.
>
> XXXXX.XX Payment of Incentive – Each payment will be paid separately from all other Contract payments. Incentive payments for early completion will be paid only after completion and acceptance by the Agency of the Work.

3.5 SUMMARY

ODOT's use of I/D provisions has spanned a decade. During that time, I/D contracting has primarily been used to both ensure focus on timely or accelerated delivery and to encourage contractor innovation in construction methods. While there has been a learning curve in establishing contractual terms, in understanding how project conditions may affect I/D effectiveness, and in understanding the impact on project staffing, the experience is reportedly positive overall, and I/D contracting remains a viable method for future projects.

The challenge within ODOT lies in how to institutionalize the lessons learned to provide better consistency and to allow a broader involvement in the process of developing the parameters that create I/D project success.

The background research into historic use of incentive/disincentive contracting at ODOT and at a national level identified several issues that are further developed in this research. Specifically, three major problems were identified:

1. Procedures have been developed nationally that are not yet incorporated into ODOT operations;

2. A common procedure for the use of and contracting for I/D projects has not been established; this could lead to lack of consistent performance across the Agency; and

3. The use of I/D contracting on ODOT projects has been evolutionary, using broad "rules-of-thumb" to determine contract parameters such as I/D amount, and techniques for developing the I/D amount are not gathered in a written, central form that could be used by many as a basis for further I/D contracting.

This research has addressed these problems in two ways:

1. A general process model has been developed for establishing whether a project is a candidate for use of I/D provisions; and

2. A new calculation model is proposed for establishment of the contractor's cost of acceleration and for creating a viable I/D – balanced between the contractor's cost and the public cost of delay.

4.0 DEVELOPING ODOT CRITERIA AND STANDARDS – USE AND APPLICATION

4.1 OVERVIEW

The decision to accelerate a project involves many factors, both external and internal to the project. External factors include political pressures, legal constraints, funding availability, and ODOT staffing capability. Internal factors include project complexity, project duration, etc. Various decisions surrounding the use of I/D projects are required, and these decisions occur during different phases of project development. This section outlines a proposed process for deciding on the appropriateness of using incentive/disincentive (I/D) practices on a project, as well as a methodology to implement these practices.

In Section 5 a new calculation model is proposed for establishment of the contractor's cost of acceleration and for creating a viable I/D – balanced between the contractor's cost and the public cost of delay. Implementation approaches for these research results are suggested in Section 6.

4.2 I/D IMPLEMENTATION PROCESS

Figure 4.1 represents a proposed I/D contracting implementation process. Each phase in the process is explained below.

4.2.1 Project initiation and preliminary design

4.2.1.1 Determine the need to speed the project

The Region in which the project is located should decide on the need for acceleration of the project schedule based upon the project's goals. The Region should consider the needs of any political entities involved in the project, the project's characteristics, and the capabilities of the project team. If a project team feels that a project would benefit from acceleration, the project leader should seek the appropriate people within the project team and the Region to handle such requests, as indicated by the latest ODOT Operational Notice.

Early on, the need to accelerate the project should be considered for specific portions; i.e., only those portions which need to be accelerated should be the subject of an I/D provision. During the Project Initiation phase the project team should evaluate the project's goals and the social and physical environment surrounding the project. While the decision to use I/D provisions may be introduced at later project stages, it is at the Project Initiation step that the decision to use I/D will be most effective.

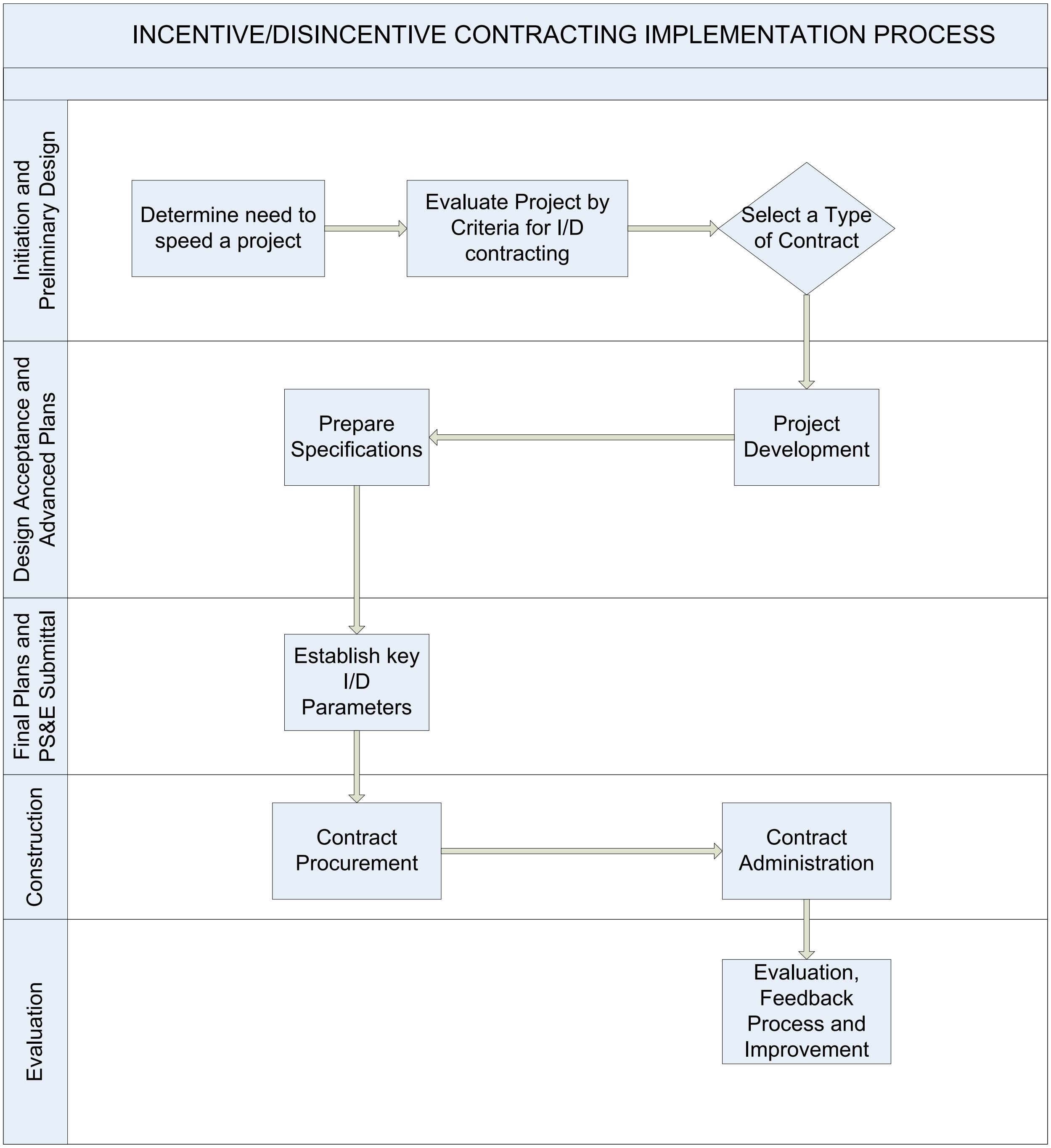

Figure 4.1: I/D implementation flowchart

In general, the implementation of I/D provisions adds additional administrative overhead to a project. Therefore, to minimize this effect, it is recommended that the following criteria be considered as a threshold condition for implementation of Incentive and Disincentive provisions:

- Projects under $5 million should not be considered unless a specific cost/benefit analysis is developed that indicates otherwise; and

- The portions of the project which are the focus of the I/D project must be at least three months in duration.

If a project meets the minimum guidelines for implementation of I/D provisions, the project team should establish whether there is a potential benefit for its use. When doing the analysis to determine if a project needs to be accelerated, ODOT should consider the following objectives, presented in NCHRP Report 451, Guidelines for Warranty, Multi-parameter, and Best Value Contracting (*2001*):

- Shorten Project Duration: The number one reason to implement I/D contracting is to reduce the time it takes to complete the construction of highway projects beyond what has historically been achieved with traditional highway contracting;

- Reduce Inconvenience to the Traveling Public: Shortened project durations translate into reduced levels of inconvenience to road users and minimized congestion. Rerouting of traffic occurs for shorter periods of time;

- Lessen Potential Impact on Local Businesses and Communities: Shortened project durations reduce the time that business access is potentially disturbed. On some I/D projects, a contract upon which I/D values are to be applied may consist of a roadway that restricts access to local businesses and neighborhoods; and

- Improved Perception of Construction by Public: The Use of I/D provisions will decrease the time required for construction. This means that the traveling public will observe that progress is made on a consistent and continuing basis. Agencies have been subjected to public criticism because of what appears to be long periods where contractors are not seen working on the project consistently.

4.2.1.2 Evaluate project by criteria for I/D contracting

Note that although the analysis may indicate that I/D implementation should be considered, other factors inherent in the project, such as unresolved utility issues or lack of project administrative capacity, may be cause to reject I/D use. At this early stage of the project, many specific details may be yet undiscovered; however, there may be some apparent "negative" factors which would "block" the use of incentive/disincentive contracting on the project.

This analysis may be accomplished by consideration of the list of factors in Table 4.1, I/D Project Suitability Checklist; the existence of several "no" indications in the Project Suitability Checklist should be cause for management review and possible rejection of use of I/D contracting. The 1989 Technical Advisory recommends that I/D provisions should not be used routinely, but only for completion of projects or portions of projects for which one or more pre-selected criteria exist (*FHWA 1989*); such pre-selected criteria should be established through an administrative document such as the ODOT Office of Project Delivery Operational Notice.

Table 4.1: I/D project suitability checklist

Characteristic	Yes/No
Public Inconvenience	
Where high-traffic volumes exist, typically in urban areas	
Where traffic restrictions, lane closures, or detours result in high road user costs (RUC)	
Major reconstruction or rehabilitation on an existing facility that will severely disrupt traffic	
Lengthy detours of high traffic volumes	
Constructability	
A contractor's expertise is needed to facilitate an earlier completion	
The I/D phase(s) can be completed in one construction season or less	
Traffic control phasing can be structured to maximize a contractor's ability to reduce the duration of construction	
The project is relatively free of utility conflicts, design uncertainties, or right-of- way issues which may impact the bid letting date or the critical project schedule	
Availability of contractors with sufficient resources	
Public Safety	
Safety concerns during construction, including impacts to public, pedestrian, and/or worker safety	
Disruption of emergency services	
Emergency response to an unexpected loss of highway facility	
Public Priority	
Project completion by a specific date is in the public's interest	
Adjacent neighborhoods or businesses would suffer a significant impact	
Project will complete a gap in the highway system	
Major bridges will be out of service	
Completion time constraint	
Interference with major public events	
Highly sensitive project due to businesses impacted or political issues	

4.2.1.3 Select a type of contract

Once the project has met the criteria for becoming an I/D project, the next step is to decide what type of bidding and contracting method should be used. Incentive/Disincentive provisions have been used in two different methods of bidding and contracting: I/D only and A+B +I/D.

I/D only is the typical low bid method in which ODOT specifies the time required for critical portions of the work where traffic inconvenience and delays should be minimized. This method has been used often by ODOT; however, many practitioners argue that when the contract time is determined by the DOT, the contract time requirements may not be very accurate and may be on the high side. Therefore, the contractor would easily be able to save some time and earn an incentive without making special effort.

With A+B +I/D each bid submitted consists of two components: the cost for the contract items and the total number of calendar days required to complete the portion of the project that is subject to the I/D. The bid for award consideration is based on a combination of the bid for the contract items and the associated cost of the time. FHWA recommends that an I/D provision be used with an A+B contract. However, this form of contracting requires special approval that, especially if considered in the late stages of project development, could add time to the project and possibly negate the time-value of instituting I/D provisions.

ODOT should understand under what project conditions each type of I/D contracting is most effectively applied.

4.2.2 Design acceptance and advanced plans

4.2.2.1 Project development

During the Design Acceptance phase, as the parameters and constraints of the project are discovered, a further evaluation of the suitability of the project to use I/D methods must be made. During this phase, detailed information about the project is gathered and should be used to evaluate the project against the items listed in Table 4.1, I/D Project Suitability Checklist. Substantial evidence of suitability (i.e., a substantial number of "yes" indications) among the factors in Table 4.1 must be shown to reconfirm the I/D decision.

4.2.2.2 Prepare specifications

During the development of I/D projects, extra effort should be made to ensure that the design, specifications, schedule, etc., are compatible and appropriate for the project. The plans and specifications should indicate any unusual condition or any restriction under which the contractor may be required to work, such as prohibiting jack hammering or pile driving during the night due to noise problems, or work related to environmental issues (*FHWA 1989*).

Specifications must adequately draw the bidders' attention to the unique aspects of this contracting method. Due to possible conflicts with any standard specifications, a careful reading of established specifications should be made to ensure that conflicts are eliminated. Considerations should be given to standard specification sections dealing with bid award, scheduling, contract time and adjustments, definitions, liquidated damages and others. New specifications must be included that describe the incentive/disincentive program.

Incentive/disincentive provisions are increasingly common; therefore pre-bid conferences are not considered necessary unless a project has unusual features or processes that are not commonly understood by the potential bidders. If there is consideration for pre-bid conferences, then pre-bid conferences should be held during the Design Acceptance stage. At this point, contractor input may affect the implementation of the I/D provisions.

During the development phase of the project, all parties (e.g., local officials, police, local traffic engineers, construction engineers, etc.) should be involved in the project development. To ensure I/D success, a constructability review should be considered on projects over $50 million.

4.2.3 Final plans and PS&E submittal

During this stage of the I/D implementation process, key parameters for the contract must be determined. These include the determination of Road User Costs, I/D amount, I/D cap, maximum time allowed and minimum time allowed for the incentivized portion.

4.2.3.1 Establish key I/D parameters

4.2.3.1.1 Incentive amount and duration

The amount of the incentive should be assessed as a fixed percentage of the project or fixed dollar amount per calendar day, up to a maximum percentage of the total calendar days of the project (or fixed maximum days), counted from the actual date of completion to the established estimated completion date. Any partial day should be rounded to the next nearest whole day. The maximum incentive award to be paid under the contract will not exceed the award per day multiplied by the maximum amount of days where an award is attainable.

It is very important to determine an appropriate dollar amount per day for I/D provisions for early completion of projects. To be effective and accomplish the objectives of I/D provisions, the FHWA Technical Advisory recommends that the dollar amount be of sufficient benefit to the contractor to encourage his/her interest, stimulate innovative ideas, and increase the profitability of meeting tight schedules (*FHWA 1989*). If the incentive payment is not sufficient to cover the contractor's cost for the extra work (additional crews, overtime, additional equipment, etc.), then there is little incentive to accelerate production, and the I/D provisions will not produce the intended results.

The value of the road user cost is predetermined by ODOT and, if it becomes the basis of the I/D or is used for determination of the B portion of the bid, it should be specified in the proposal. Costs attributed to disruption of adjacent businesses should not be included in the daily I/D amount. Engineering judgment should be used to adjust the calculated daily amount downward from the RUC (not upward) to a final daily I/D amount that:

- “Provides a favorable benefit/cost ratio to the traveling public where the cost is the daily I/D amount and the benefit is the calculated daily savings in road user and Department of Transportation costs; and
- “Is large enough to motivate the contractor. If a favorable benefit/cost ratio cannot be realized and/or the resulting daily amount is not high enough to

> motivate a contractor, the project should not be further developed as an I/D project" (*FHWA 1989*).

Whichever method is used to determine the I/D amount, the allocation for the potential award of the entire incentive amount should be factored into ODOT's construction budget (*Anderson and Russell 2001*). A cap of 5 percent of the total contract amount is recommended as the maximum incentive payment.

A base schedule must be concurrently developed that includes standard production rates that are achievable by a normal contractor utilizing a reasonable amount of effort. Attempts to constrain a base schedule by introducing acceleration before bid should not be used unless the full impact on the bidding market is determined. Often such pre-bid acceleration may cause a reduction in bidders and therefore poor competition, leading to higher bid amounts. For any I/D portions identified, the project manager should also estimate a reasonable amount of time available for acceleration of the focal portion using CPM techniques. The techniques used for these analyses should follow the same methodologies as those used for the project as a whole

4.2.3.1.2 Disincentive amount and duration

The disincentive amount should be established as the same amount per day as the incentive amount, for a total disincentive amount that should not exceed and preferably be equal to the total incentive amount. Similarly, disincentive durations should also be similar to incentive durations.

Disincentives should not be assessed concurrently with liquidated damages. If the agency ceases to assess the disincentive(s), the applicable liquidated damages can be assessed.

4.2.4 Construction

4.2.4.1 Contract procurement

In practice, two forms of bidding are often associated with I/D contracting – Price-only and A+B bidding. Price-only bidding selects a bidder based solely on the cost a bidder proposes for completion of the work based on a minimum completion time determined by ODOT. (This is the "traditional" means of obtaining bids.) In A+B bidding, a bidder is selected based on the bidder's proposed cost and the bidder's proposed schedule. Sources recommend the use of A+B bidding for I/D projects; however, it should be noted that currently in Oregon, administrative policy requires that proposed A+B contracting receive approval of the Oregon Department of Justice. The process required to obtain this approval may add additional time to project development and in some circumstances may create delay to the overall end date. This circumstance will act counter to the desire to accelerate the project if the contracting selection is made late in the project development process. In this case (as has been the case for several existing projects), the more prudent choice may be to use traditional I/D only (or "price-only") bidding.

The advertisement of bids for an I/D project should follow the same process as used for traditional contracts, with the exception of noting the project as an I/D project.

Allocation of risks should be done using the basic principle that the party best able to control or manage the risk should take responsibility for that risk. If contractors perceive high externally-caused risks that are not adequately addressed, they may increase their bid proposals to take into account potential difficult-to-predict costs.

4.2.4.2 Contract administration

During pre-construction conferences, the project team should highlight the reason for the I/D provision and discuss in detail the portion which is the focus of the incentive. All parameters of the I/D provision should be discussed, including any potential obstacles or concerns held by the contractor.

I/D projects may increase the amount of ODOT work required. This should be evaluated and committed to prior to the start of contract administration. Appropriate levels of resources, including personnel, equipment and materials, must be available to both the DOT and the contractor to accomplish an I/D project.

During the construction phase, decision-making and approval must be promptly provided to the contractor at all times that I/D work is in progress. Discussions between ODOT and the contractor should consider future critical operations and potential problems. Coordination between the major parties involved may require more input from design personnel and the contracting community. Planning should reflect this additional effort. Conflicts must be resolved in a timely manner to avoid delays.

The contractor should be required to submit a Critical-Path Method (CPM) schedule for review and approval prior to starting work. The CPM schedule will be used to gauge and analyze the contractor's progress, determine time adjustments, and evaluate claims. The contractor will be required to update the CPM schedule on a regular basis in conjunction with the regularly scheduled job site progress meetings. During the life of the contract, the contractor must meet all milestones and completion dates.

4.2.5 Evaluation

Continued improvement of the I/D process depends on increased experience gained through project completions. Therefore, at project completion a thorough, recorded evaluation of the successes and challenges surrounding the I/D implementation should be made. These evaluations provide feedback and should be used to improve the process. They should be kept in a central location and referenced in the development of future I/D projects.

4.3 SUMMARY

The decision to use incentive/disincentive contracting should occur early in the project's life – at Project Initiation. If this decision is made later in the project sequence, the ability to make critical design and/or procurement decisions that enhance the I/D methods may be lost. As may be seen in this section, most of the project conditions which determine appropriateness of use of I/D methods are known at the earliest stages. Although the decision to use I/D methods should be made early, significant work on successfully implementing I/D projects occurs throughout the project cycle. In fact, at each stage – design, procurement, and construction – the project manager must be diligent in considering appropriate alternatives, assigning proper contract language, communicating ODOT's goals to bidders, and properly administering the work to completion.

5.0 MODELING THE ECONOMIC BALANCE OF I/D VALUES

5.1 OVERVIEW

One of the most significant factors in I/D contracting is the establishment of the value of the incentive (and disincentive). Previous research recommends that the incentive be set at more than the "lower boundary" of the contractor's cost of the acceleration (plus a reasonable profit), but at less than the "upper boundary" of the cost of the delay to the public. This latter value is usually established through the calculation of Road User Costs (RUCs), which calculation is commonly performed by ODOT. However, there is a lack of working-level techniques to establish the "lower boundary" of the contractor's cost of acceleration plus reasonable profit.

In this section, a method of economic analysis to determine the contractor's costs for acceleration is presented. A model is developed that utilizes "lower boundary" and "upper boundary" parameters, based on evaluations of contractors' costs and Road User Costs (RUCs), to establish an effective I/D amount. While the model is later demonstrated in Microsoft Excel, the calculation methodology could be performed on a standard form, a calculator, or on a different spread sheet program.

It is commonly assumed that there is an optimal time for construction, at which point construction cost is the lowest. Either slowing or accelerating the construction schedule will increase the cost; therefore, to encourage schedule improvement, ODOT must offer a financial incentive to transportation contractors to accelerate a portion of a project. It is difficult, however, to determine the contractor's cost of schedule change. Breaking down the cost of construction into its components will assist in determining the overall cost of accelerating a particular portion of a project.

To determine an appropriate I/D[1], an analysis of the components of the contractor's costs for the focus portion of work is necessary. The effect of acceleration on the components of cost may then be summed to establish acceleration cost (CA), to which a "profit" incentive is added, and then compared against Road User Costs to subjectively, yet methodically, establish an appropriate daily I/D amount. In the case of a simple bonus, the bonus amount would be simply the daily I/D amount multiplied by the number of days targeted for application of the bonus.

Establishing the I/D value requires a model that approaches the problem in two stages. In Stage I, the project costs and schedule estimates for the entire project and for the portion that is to be the focus of the I/D are established and, based on bidding market conditions and project complexity, a breakdown of costs and profits is determined. Base costs are broken into generic cost categories (such as labor, materials, equipment, etc.) In Stage II, the project manager

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[1] The term I/D is used here to indicate that establishment of the incentive by default also establishes the disincentive. The process of determining acceleration cost is clearly focused toward determining incentives. Yet, it should be noted that disincentives are usually set equal to incentives.

considers the unique characteristics of the project and uses engineering judgment to establish the costs of schedule compression. This analysis provides guidance in setting the final I/D amount by combining the cost of acceleration with estimates of profit. These stages are shown graphically in Figure 5.1: as the I/D Valuation Model.

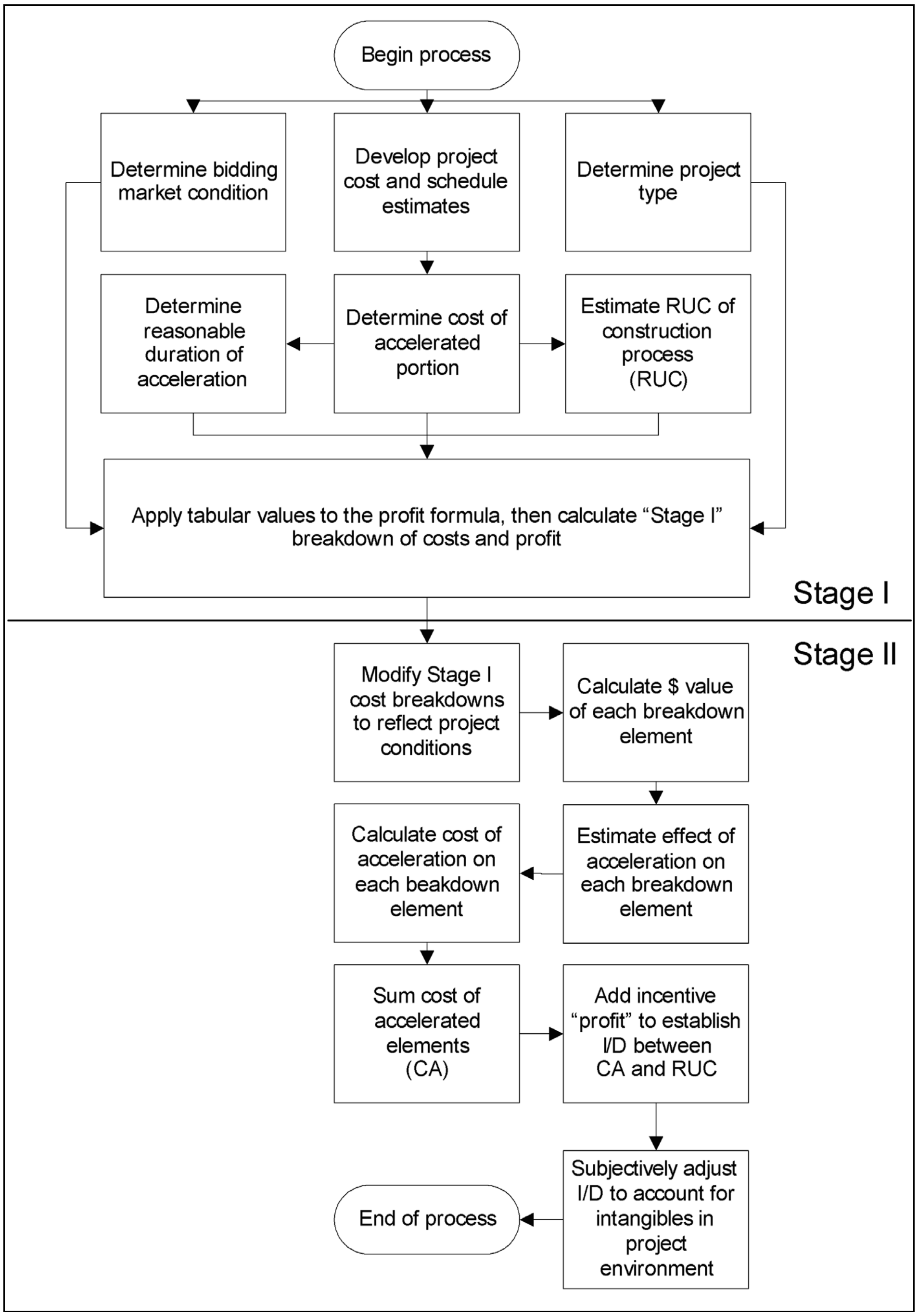

Figure 5.1: I/D Valuation Model

It is important to estimate profit when establishing incentive amounts. Clearly, any incentive amount must cover any direct costs a contractor spends in performing acceleration, but it should also include a profit value that would cause a contractor to shift his resources to the acceleration. Otherwise, the contractor would tend to shift resources to other market opportunities where larger profits could be realized.

Unfortunately, project profits are rarely exposed on projects and are therefore difficult to estimate. A simple, generic formula which models fee structures for designers was described by Carr and Beyor (*2004*). The formula used empirically-obtained values to model categories of projects, such as warehouses, schools, hospitals, etc., accounting for varying complexities of projects. While Carr and Beyor applied the fee formula to design fees, exploration of the formula by ODOT Technical Services revealed its robust nature, and the formula was simplified to that shown in Equation (5-1) – where P represents a forecasted profit at bid time, f is a factor representing project type (and thus complexity), C is the estimated total project cost, and m is a factor representing the market condition. For a given project, C (the total project cost), is known. What must be determined, however, are the two factors f (project type) and m (market condition). These two factors are further explored in the discussion which follows.

$$P = f \Big/ \left(\mathrm{Log}(C)^{m} \right) \tag{5-1}$$

5.2 STAGE I: MODELING OF ACCELERATION INCENTIVE

Stage I of the I/D Valuation Model requires three specific inputs, the development of which may occur concurrently. Principal of these inputs – an estimate of cost and time for the entire project – is a common activity for all projects within ODOT. Two additional inputs are project type and market condition. These two latter inputs are traditionally anecdotal information used to give the estimator a sense of fine adjustments to be made to the final estimate. The model proposed here uses empirically-derived tables of values to quantify these factors, and then uses these tabular values to model the relationships established in Equation (5-1).

5.2.1 Developing the project cost and schedule estimates

Development of the base project cost estimate and schedule begins with an ODOT estimate for the entire project, followed by an estimate of the portion that is to be the focus of the I/D. Using an historical data base of costs, (ODOT utilizes AASHTO's Trns*port® software) an estimate that includes all of the contractor's costs – including direct and indirect costs and markup – is developed. If particular items such as mobilization and demobilization are not historically included in the work items, they must be appropriately added to create a total cost estimate for the portion of accelerated work. A base schedule must be concurrently developed that includes standard production rates that are achievable by a contractor utilizing a reasonable amount of effort.

Two factors must be further developed and evaluated to establish an I/D amount: Road User Costs (RUCs) and critical start and completion times. For any portion of the project that involves significant public traffic delay, the Road User Cost (RUC) of the delay should be calculated. Situations of significantly high RUC should be identified as potential targets of I/D contracting. Further, once the overall project cost and schedule estimates are completed, the project portions that contain critical (or near-critical) start and completion times are similarly identified. The likelihood of completion of the work is evaluated by analysis of available float time for activities within the project portion. Portions with "near zero or negative float" need further consideration for the use of I/D methods to encourage contractor attention to completion within the specified duration. For portions of work that contain either high RUCs or critical schedules, a project decision must be made, involving appropriate engineering and managerial input as to which portion(s) should be developed for I/D use.

For any I/D portions identified, the project manager should estimate a reasonable amount of time available for acceleration of the focal portion using CPM techniques, the base (or unaccelerated) cost estimate of that portion, and the daily RUC. The techniques used for these analyses should follow the same methodologies as those used for the project as a whole.

5.2.2 Determining the bidding market condition (*m*)

Bidding market conditions (*m* in Equation (5-1)) have a substantial effect on construction pricing. It is a well-understood principle that there is a correlation between the number of bidders and the profit for a given project (*Friedman 1956*). The larger the number of bidders (i.e., the "slower" the market), the smaller are the profit margins in the bids. Conversely, in markets where contractors are busy and new projects are plentiful (a "busy" market), there are fewer bidders who will tend to raise their profits, as both risk and opportunity increases. To understand market trends, many Departments of Transportation, including ODOT, track the number of bidders.

As a starting point to create distinction in the proposed model, three states of market condition were established. These states are "busy", "normal", and "slow". Admittedly, these are broad generalizations of what may be complex market factors. The intent here is to establish a means to recognize some level of market differentiation and the effect that such differentiation has on the profit applied to transportation projects. Further development of these factors would be useful.

5.2.3 Project type as an indicator of project complexity (*f*)

Project complexity (*f* in Equation (5-1)) may affect the project estimate in many ways; two significant effects are changes in allocation of project resources and changes in profit to account for varying degrees of risk due to complexity. To create a simple method of indicating complexity, a series of factors was applied to various types of projects. Typical ODOT projects may be broken into broad categories; an example would be the following categories:

- Roadway and Preservation,
- Interchange, and
- Bridge.

The above types are listed in order of increasing complexity, and they will vary in the proportion of materials and construction means applied to the project. In addition to the above three types, a category of "complex" was introduced into the model to make it more robust and to recognize that some projects do not meet the simplified descriptions of the three definitive types.

In developing "typical" parameters for each project type, average projects were conceived as those which use commonly-understood techniques and readily available materials, involving minimal demolition and little environmental hazard.

By definition, projects are unique, and the environments in which they are constructed may vary substantially, so the nature of these categories is very broad. Of course, the line between such designations is seldom clear, since many projects contain elements of each. Engineering judgment is required to modify any general analysis to reflect such compromise situations; that judgment is applied in the Stage II analysis.

5.2.4 Tables of empirical factors, *f* and *m*

Through a trial-and-error evaluation of Equation (5-1), the two primary factors, *f* and *m*, were empirically derived by personnel at ODOT Technical Services, using principles of FHWA's Guidance TA508064 (*FHWA 2004*) and historic values contained in AASHTO's Trns*port® Estimating System (*AASHTO 2006*). Market conditions and project type (using project type as a proxy for complexity, see discussion above) were evaluated, and the results are indicated in Tables 5.1 and 5.2. To illustrate use of these factors through an example, the empirically derived factors from the tables produce the family of profit curves shown in Figure 5.2 for a "typical" roadway project. The profit values are used as an element in the cost breakdowns discussed below.

Table 5.1: Factors *f* used in Incentive Determination Model

Project Type	Description	*f* Factor
A	Roadway	1.00
B	Interchange	1.10
C	Bridge	1.25
D	Complex	1.35

Table 5.2: Factors *m* used in Incentive Determination Model

Market Condition	Description	*m* Factor
AA	Busy	1.40
BB	Normal	1.50
CC	Slow	1.60

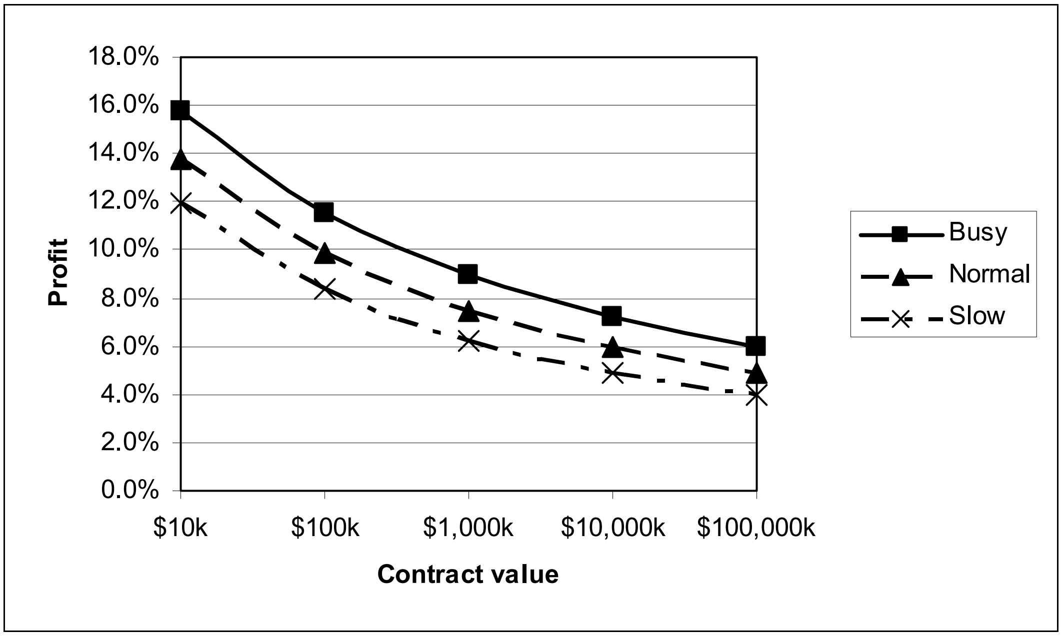

Figure 5.2: Family of profit curves for "typical" roadway project

5.2.5 Breaking down the cost of construction

In order to estimate the cost of acceleration, the project manager must have insight into the individual elements and sub-elements of cost contained within a total project estimate. The purpose of obtaining such a breakdown is to allow the manager to consider that the sub-elements of direct cost (labor, equipment, and materials) may be affected differently by an acceleration effort. Since typical ODOT estimating methods do not reveal such estimate detail, a broad method for establishing such a breakdown must be developed. This research proposes a method for breaking down the estimate, based on historic relationships among project costs.

Figure 5.3 graphically shows a relative breakdown into elements of the total costs of a project (or of a portion of a project) and are included here to provide the reader with a sense of the relative magnitudes of these elements (*Bartholomew 2000*). Actual breakdowns will vary across contracting companies, across projects within companies, and may change with changes in market conditions and with project complexity. However, the relative order of magnitude of the relationships of the elements in Figure 5.3 is a fundamental basis for cost structures within the competitive bid market and has been proven at ODOT over many years of contract bidding. The purpose here is to further breakdown this global set of elements as a starting point to determine acceleration costs for a particular situation.

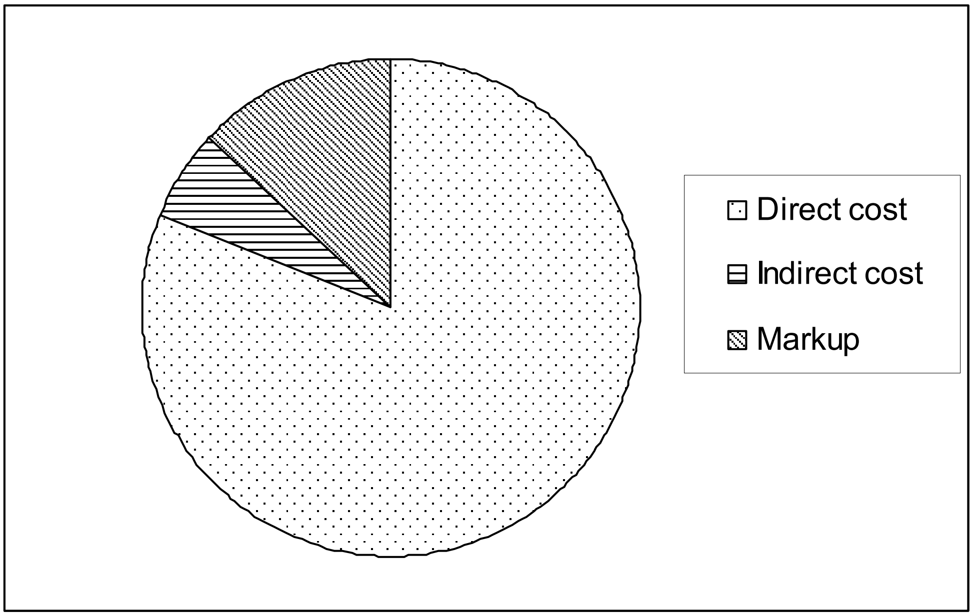

Figure 5.3: Breakdown of total cost

Two major factors complicate attempts to break project cost into its components. First, detailed breakdowns are rarely revealed to ODOT. It is common that pricing is received by ODOT as unit cost or lump-sum, and separation into elements of cost, such as direct, indirect, and markup, is not obvious on a project-by-project basis. Second, bidders may approach the same project using a different mix of resources. ODOT has undertaken global studies of project cost elements, and it is these global, and generalized, breakdowns that are used in the model.

The three elements noted in Figure 5.3 are very broad. A further breakdown of these elements is needed for a reasoned analysis of acceleration cost. The following discussions expand these elements into sub-elements. To develop the generalized percentages for the sub-elements, experts at ODOT Technical Services used historic costs from Trns*port® (*AASHTO 2006*) and breakdowns presented in Means Cost Guides (*Chandler 2002*; *Waier 2003*) to populate a table of breakdowns, varying by project type. The cost breakdowns have been utilized elsewhere in ODOT for financial forecasting of such items as project inflation. These generalized percentages – shown in Table 5.3 through Table 5.5 – are included in the model only as a "Stage I" approximation, to be further evaluated by each project manager for each project. These breakdowns are discussed in more detail below.

5.2.5.1 Direct cost

Table 5.3 represents sub-elements contained within direct cost. Note that the "Stage I Value" for subcontract cost is set to zero. It is assumed that any subcontractor's project cost breakdowns will be similar to the prime contractor's costs; therefore any acceleration costs would be proportionally the same. Although there may be some minor additional profit built into any subcontracted costs, these are assumed to be too small to consider, especially in view of the broad assumptions made elsewhere in this analysis. If subcontract costs are unusually high for a portion of the project, then an analysis should be made of the applicability of this assumption.

Table 5.3: Breakdown of direct costs

		Roadway	Interchange	Bridge	Complex
Element*	**Sub-element****	**Stage I Value**	**Stage I Value**	**Stage I Value**	**Stage I Value**
Direct cost		81%	78%	79%	77%
	Labor	25%	30%	30%	33%
	Materials	45%	35%	30%	37%
	Equipment	30%	35%	40%	30%
	Subcontract	0%	0%	0%	0%

* Stated as a percentage of total project cost
** Stated as a percentage of total direct cost

5.2.5.2 Indirect cost

Indirect costs are broken down into sub-elements as shown in Table 5.4; the sub-element figures are percentages of total direct cost. For the purposes of I/D determination, the amount of acceleration of a portion of work is assumed to be relatively short (in the range of a fraction of a year), and thus there would no appreciable effect on the time value of money.

Table 5.4: Breakdown of indirect costs

		Roadway	Interchange	Bridge	Complex
Element*	**Sub-element****	**Stage I Value**	**Stage I Value**	**Stage I Value**	**Stage I Value**
Indirect Cost		6%	9%	8%	9%
	Supervision	2%	3%	2%	4%
	Time-related facilities	1%	1%	1%	1%
	Non-time-related facilities	1%	1%	1%	1%
	Mobilization/demobilization	3%	5%	5%	5%
	Insurance and taxes	1%	1%	1%	1%

* Stated as a percentage of total project cost
** Stated as a percentage of total direct cost

5.2.5.3 Markup

Markup is broken down into three broad sub-elements, as shown in Table 5.5. The estimate of the sub-element, Profit, is particularly important, since it becomes a key factor in evaluating the final amount of the I/D; it is calculated independently using Equation (5-1), as discussed above. Risk is a highly subjective value; the "Stage I Value" shown is only a starting point for an entire project. Typically, project portions that warrant the application of I/Ds are somewhat difficult to perform due to high existing traffic volumes. Therefore, special consideration should be given to choosing appropriate profit and risk values. Home Office G&A denotes the percentage of corporate-level General and Administrative (G&A) expenses that contractors typically proportionately apply to each project.

Table 5.5: Breakdown of markup

		Roadway	Interchange	Bridge	Complex
Element*	**Sub-element****	**Stage I Value**	**Stage I Value**	**Stage I Value**	**Stage I Value**
Markup		12%	13%	14%	14%
	Risk	3%	5%	5%	6%
	Home Office G&A	8%	8%	8%	8%
	Profit (Calculated separately)				

* Stated as a percentage of total project cost (Profit assumed to be 4.3% for all types)
** Stated as a percentage of total direct cost

5.2.6 Modeling the total cost breakdown of a proposed project

The model proposed in this research uses two functions to develop a percentage breakdown of project costs, including a projection of profit. First, the model uses the assigned project type, *f*, to establish the relationship among the sub-elements on a typical project. These values are read from Tables 5.3 through 5.5 and are applied to the total project cost. Concurrently, the project profit is estimated using Equation (5-1) by applying the factors *m* (market condition) and *f* (project type) – both of which are determined by the project manager.

The result is a breakdown of total project cost reported as an initial "Stage I" approximation of each of the major sub-components of cost. This approximation serves as guidance as the project manager moves to "Stage II," which requires customizing these approximations to better model the specific project. An example of the Stage I process is given below.

5.2.7 Stage I example

To illustrate the principles discussed above for Stage I modeling, Table 5.6 presents the results of an analysis for a theoretical, example project. This example is based on theoretical project conditions as indicated in Table 5.6. These conditions are used to establish cost breakdown factors (from Tables 5.3 through 5.5). Further, profit is calculated by using Equation (5-1) and factors *f* (project type) and *m* (market condition), which are read from Tables 5.1 and 5.2 above. These processes are discussed in more detail below.

Table 5.6: Example project input values

Project Example	
Type:	A (Roadway)
Market Condition:	CC (Slow)
Total project estimate:	$20,000,000
Total direct cost of I/D portion:	$2,000,000
Reasonable acceleration target:	10 Days
Estimated RUC/Day for I/D portion:	$35,000

The example project conditions are used to break down the total project estimate into percentages of its elements and sub-elements. The process begins with the following steps:

1. Using the indicators of project type (A – Roadway) a factor *f* of 1.00 is read from Table 5.1.

2. Using the market condition assessment (CC – Slow) a factor *m* of 1.60 is read from Table 5.2.

3. The values of *f* (1.00) and *m* (1.60) and the project value ($20,000,000) are substituted into Equation (5-1) to determine a profit value of 4.2% (rounded to one decimal place). The reader is encouraged to evaluate the equation and/or estimate the value from Figure 5.2.

4. Using the project type (A - Roadway), estimated percentage breakdowns are read from Tables 5.3 through 5.5. For example, the percent for Supervision (a sub-element of Indirect Cost) is read from Table 5.4 as 2%.

The result of steps 1 through 4 above is shown in Table 5.7. Note that the percentages shown for the Elements in Table 5.7 (Direct Cost, Indirect Cost, and Markup) are percentages of total project cost, rounded to the nearest whole percentage; some rounding error may be introduced.

Table 5.7: Example Stage I values

Element*	Sub-element**	Stage I Value
Direct cost		81%
	Labor	25%
	Materials	45%
	Equipment	30%
	Subcontract	0%
Indirect Cost		6%
	Supervision	2%
	Time-related facilities	1%
	Non-time-related facilities	1%
	Mobilization/demobilization	3%
	Insurance and taxes	1%
Markup		12%
	Risk	3%
	Home Office G&A	8%
	Profit	4.2%

* Stated as a percentage of total project cost
** Stated as a percentage of total direct cost

5.3 STAGE II: MODELING OF ACCELERATION INCENTIVE

Stage II modeling is essentially the process of subjectively factoring the Stage I cost breakdowns for the unique characteristics of the individual project. The starting point of the Stage II process consists of the factored percentage breakdown of costs provided by the Stage I analysis, whereby the total estimate of the project has been broken into its parts using the factors discussed in the previous section.

At this stage, three important sets of input are required of the user – adjustment of the global breakdown values, estimation of acceleration impact on the portion elements, and assignment of the incentive "profit." The result will be establishment of the portion-focused incentive (and disincentive), which will be judged for reasonableness; i.e., does the proposed I/D fall between the cost of acceleration, as a "lower boundary," and the public cost of delay (RUC) as an "upper boundary?"

5.3.1 Subjective adjustment of the project breakdown

Illustration of the Stage II subjective adjustments is best explained using an example. Therefore the theoretical example offered in the Stage I discussion above will be used in the following discussion.

Table 5.7 showed the Stage I estimate of an example project breakdown in the column entitled Stage I Value, based on the theoretical, example project conditions specified in Table 5.6. These percentages are by nature very general, and they are intended as a starting value for the user to make more reasoned estimates of the breakdown of costs. (For a full discussion of these issues, please see the explanations in the preceding Stage I section.) The user should adjust the starting values to better reflect the actual project, and the nature of the portion that is to be accelerated.

Drawing upon the example from the previous section, Table 5.7 shows a value of 25% for labor; however, the identified portion may call for a higher percentage of labor due to a special condition such as extraordinary handwork – in which case, the user may increase the labor value to, say, 30% and then decrease the values for materials and/or equipment to balance to 100%. This same review and adjustment would occur for each sub-element as shown in Table 5.8 in the Portion Specific Value column.

Table 5.8: Stage II adjustment of example project

Element*	Sub-element**	Stage I Project Breakdown	Portion-specific Breakdown	Portion specific value ($)
Direct cost		81%	76%	2,000,000
	Labor	25%	30%	600,000
	Materials	45%	42%	840,000
	Equipment	30%	28%	560,000
	Subcontract	0%	0%	-
Indirect Cost		6%	8%	220,000
	Supervision	2%	2%	40,000
	Time-related facilities	1%	1%	20,000
	Non-time-related facilities	1%	1%	20,000
	Mobilization/demobilization	3%	5%	100,000
	Insurance and taxes	1%	2%	40,000
Markup		12%	15%	406,000
	Risk	3%	5%	100,000
	Home Office G&A	8%	10%	200,000
	Profit	4.2%	5.3%	106,000
Total			100%	2,626,000

* Stated as a percentage of total project cost
** Stated as a percentage of total direct cost

When complete, the Stage II model calculates the estimated dollar amount for each of the sub-elements of cost, based on the user's adjustment of the Stage I cost breakdown. The column entitled "Portion specific value" in Table 5.8 provides a cost estimate of the sub-elements within the portion to be accelerated.

5.3.2 Estimating acceleration impact on the portion elements

Once the accelerated portion sub-elements have been estimated, the user is asked to apply project knowledge and engineering judgment, through common tools such as parametric estimating and simple CPM scheduling, to estimate the percentage increase in each of the sub-elements that would be caused by acceleration of the portion. Continuing the example project, if double shifting is expected, perhaps labor may incur (due to inefficiency and special wage provisions) an increase of, say, 20%. Drawing from the column in Table 5.8 labeled Portion Specific Value, Table 5.9 shows that the Labor sub-element amount would increase by $120,000. The same analysis continues for each sub-element except profit (which is dealt with later). Each sub-element of acceleration cost is then summed to find the estimated non-profit cost of acceleration (CA) – totaling $203,800 in Table 5.9; since the duration of acceleration is estimated at 10 days, this equates to an acceleration value of $20,380 per day.

Table 5.9: Acceleration impact of example project

Element*	Sub-element**	Portion specific value ($)	Acceleration impact (+/- %)	Acceleration cost (+/- $)
Direct cost		2,000,000	8%	150,800
	Labor	600,000	20%	120,000
	Materials	840,000	5%	42,000
	Equipment	560,000	-2%	(11,200)
	Subcontract	-	0%	-
Indirect Cost		220,000	1%	3,000
	Supervision	40,000	10%	4,000
	Time-related facilities	20,000	-5%	(1,000)
	Non-time-related facilities	20,000	0%	-
	Mobilization/demobilization	100,000	0%	-
	Insurance and taxes	40,000	0%	-
Markup		406,000	12%	50,000
	Risk	100,000	50%	50,000
	Home Office G&A	200,000	0%	-
	Profit	106,000	See below	See below
Total		2,626,000	8%	203,800

* Stated as a percentage of total project cost
** Stated as a percentage of total direct cost

5.3.3 Assignment of incentive "profit"

Finally, once the user has applied engineering judgment to estimate the project's cost breakdown and acceleration costs, an incentive "profit" must be applied. This amount is that which will encourage the contractor to apply its resources to the acceleration, rather than apply resources toward a more profitable enterprise on another project. Based on the project conditions established in Stage I, and the calculated value derived from Equation (5-1), the model provides a Profit neutral value – an estimation of an incentive profit that would reward the contractor at an amount that is at least as profitable as the current project. This amount is calculated from the Portion-specific Breakdown Profit percentage assigned in Table 5.8 (5.3%) times the Direct Cost Portion ($150,800) of the Total Acceleration Cost ($203,800) in Table 5.9 (a daily amount of $15,080). This amount may be seen as $799 in Table 5.10. Any amount in excess of this value would provide further incentive to the contractor; any amount less would not be as attractive. The final amount is decided on the basis of judgment of subjective factors, such as the amount of political pressure or the amount of intangible public harm that exists due to the duration of the construction. Each project manager will determine this value on a project-by-project basis.

Table 5.10: Assignment of incentive value to example project

Acceleration cost per day	$20,380
Profit-neutral value =	$799
I/D incentive profit per day (to be added to above *Acceleration cost per day*)	$3,000
Net I/D daily amount	$23,380
Total I/D profit incentive for period	$30,000
Total I/D amount for period	$233,800

As Table 5.10 indicates, the estimated, non-profit cost of acceleration on this theoretical project is $20,380 per day over a duration of 10 days. An incentive total profit of $3,000 per day (or $30,000 total) has been subjectively added to this direct cost to yield a total incentive amount that may be earned of $233,800. The test, then, is to evaluate whether the conditions of Equation (2-2) have been met. In this example, the lower bound (CA) is $203,800 and the upper bound (RUC) is $350,000 (see Figure 5.4). The total incentive amount of $233,800, then, does indeed fall between these two bounds, and additionally provides the possibility to the contractor of receiving a significantly higher percentage profit than on the rest of the project's work – encouraging focus on timely completion of the project portion.

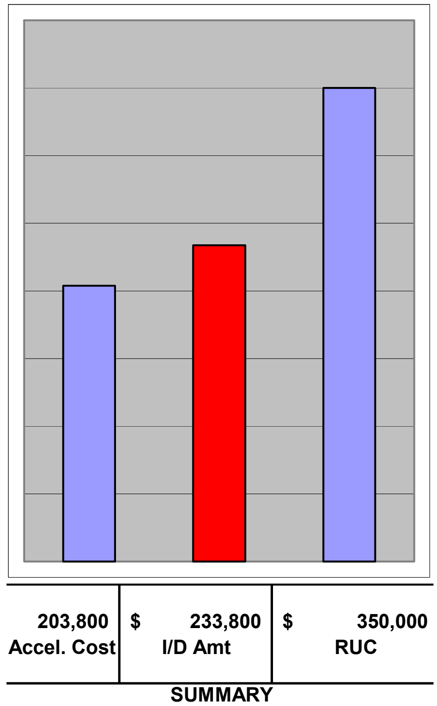

Figure 5.4: I/D value balance in example project

5.4 SUMMARY

Modeling the cost breakdowns of a proposed project is difficult. However, a project cost breakdown is useful to estimate the contractor's cost for accelerating a portion of a project and ultimately establishing an effective I/D amount. The model proposed in this section provides, as a starting basis, initial values for proportioning a total project estimate into specific cost elements and sub-elements. It then provides the project manager with the ability to modify the starting values by factoring those values based on specific project knowledge.

The model is made more robust by considering global project conditions such as the overall condition of the market (whether ODOT is competing for contractors or whether there are many contractors competing for the work), and for project complexity (described through project type, such as roadway and preservation, interchange, bridge, etc.).

Finally, an I/D amount is strongly influenced by the economics of contractor cost, but is also affected by factors such as intensity of public inconvenience and political pressure. The model, therefore, suggests a range within which I/D values would be effective, and it lets the project manager consider these additional factors in setting the final I/D amount.

6.0 IMPLEMENTATION

6.1 OVERVIEW

The final research task was to create an implementation plan so that the results of the research could be applied to ODOT operations. Two key draft products were developed to enable ODOT to further develop and apply the principles of the research. These products are a draft "Operational Notice" and a draft Excel-based tool that uses the basic concepts of the I/D Valuation Model, described above.

The ODOT unit responsible for project execution – the Office of Project Delivery (OPD) – has developed a process of publishing guidance documents entitled "Operational Notices". These notices are used to document a variety of management processes, and they provide a vehicle for creating consistency of technique across the Department.

In order to best illustrate and to provide a foundation for establishment of a balanced I/D amount, Microsoft Excel was used to write a draft "tool" for calculating rational and effective I/D amounts. The principles for the model, described above, could be applied to any number of tabular or software tools.

6.2 OPERATIONAL NOTICE

A draft Operational Notice was developed as a result of this research and presented to the ODOT Office of Project delivery for further refinement. This refined draft further develops the process of I/D contract development and execution as discussed earlier in this report. It is the intent of the Operational Notice to give direction from the earliest project phases through construction, as well as to provide a summary understanding of the basic practice that has been developed. The draft Operational Notice, designated as PD-17, is included in Appendix C. It describes the I/D decision process and provides specific guidance on each phase of project development, contracting, and construction. As of the writing of this report, the Office of Project delivery had not finalized the Operation Notice.

6.3 WORKSHEET-BASED I/D VALUATION TOOL (IVT)

Development of an I/D Valuation Tool involves combining the factors of project cost, portion cost, schedule acceleration expectations, Road User Cost, bidding market conditions, and project type – as discussed earlier. Figure 6.1 shows graphically how this information is interrelated. The proposed I/D Valuation Tool (IVT) relies heavily on experienced engineers making reasonable judgments based upon "Stage I" approximations of cost breakdowns. To make the tool flexible, easy to use, and modifiable, Microsoft Excel was used as the tool platform.

Figure 6.1 is a schematic of the proposed tool, which is made up of six separate Excel spreadsheets. The tool is based on the calculations discussed in Section 5, Modeling the Economic Balance of I/D Values.

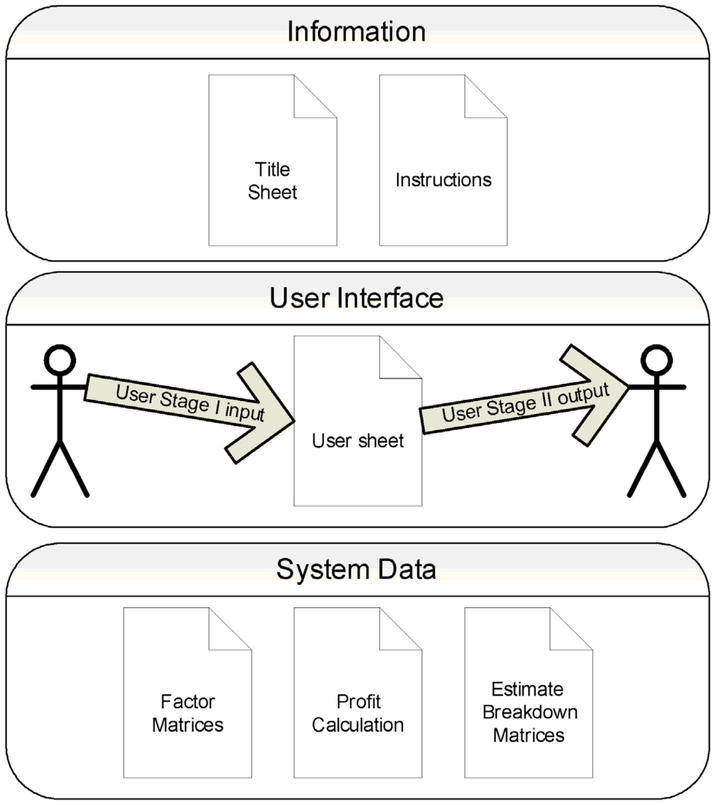

Figure 6.1: Schematic of I/D Valuation Tool

The first two spreadsheets are informational, containing the model title and instructions. The instructions advise the user on the types of information that must be generated to serve as inputs. Three spreadsheets are "system' spreadsheets (shown at the bottom of the schematic), containing base information that is maintained centrally, that does not vary from project to project, and that is used to generate the "Stage I" approximations of cost breakdowns. The user does not access these three sheets. This information was described earlier and is shown in Tables 5.1 through 5.6. Using information about the project. conditions supplied by the user, empirical factors developed at ODOT, and the formula expressed by Equation (5-1), a Stage I approximation of the breakdown of project costs and estimate of profit is produced and transferred to the user interface.

The sixth worksheet (shown in the center of Figure 6.1) is the primary user interface. Through this worksheet which is presented in Figure 6.2, the user enters the base project conditions, receives the resulting Stage I breakdown approximations, and then adjusts the approximations, along with the chosen incentive amount so that the balance of Equation (2-2) is maintained.

As of the date of this report, the draft IVT has been introduced to ODOT operational personnel to evaluate on a pilot project. It is suggested that the tool should be tested on several pilot projects, and that training be made available to potential users.

6.4 SUMMARY

This section provided two methods for moving the results of this research into applied practice. First, through the use of an "Operational Notice," ODOT's Office of Project Delivery has the means to provide guidance – informed by this research – to its project managers. This guidance will become more widely available and more consistently applied. Establishing the guidance in this manner also provides a means to capture lessons learned as I/D contracting becomes more prevalent at ODOT.

Further, using a tool to better and more rationally evaluate I/Ds, such as the draft Microsoft Excel-based I/D Valuation Tool (IVT), will create consistency, will provide an audit trail for I/D contracting decisions, and will put the offering of such incentives within the context of public accountability.

Stage I

Worksheet

Project:	Example
Type:	A
Market Cond.:	CC
Date:	8/1/2006
Project portion:	INTERCHANGE
Total project estimate: $	20,000,000
Total project direct cost estimate: $	15,232,292
Total I/D portion direct cost estimate $	2,000,000 (13%)
Reasonable acceleration target (Days)	10
Estimated RUC/Day for I/D portion ($)	35,000

Project Types:	
A	Roadway
B	Interchange
C	Bridge
D	Complex

Market Cond's:	
AA	Busy
BB	Normal
CC	Slow

Calculated cells
Reference values
Entered values

Element	Sub-element	Stage I Value %)	Project-specific value (%)	Note	Portion specific value ($)	Acceleration impact (+/- %)		Acceleration cost (+/- $)
Direct cost		**81%**	**76%**	**<Stated as % of total**	**2,000,000**	**7%**		**133,000**
	Labor	25%	25%	<Stated as % of Direct Cost	500,000	20%		100,000
	Materials	45%	45%	(Must sum to 100%, values	900,000	5%		45,000
	Equipment	30%	30%	incorrect if this square is	600,000	-2%		(12,000)
	Subcontract	0%	0%	read.)	-	0%		-
Indirect Cost		**6%**	**8%**	**<Stated as % of total**	**220,000**	**1%**		**3,000**
	Supervision	2%	2%		40,000	10%		4,000
	Time-related facilities	1%	1%		20,000	-5%	**<Stated as % of line item**	(1,000)
	Non-time-related facilities	1%	1%	<Stated as % of Direct Cost	20,000	0%		-
	Mobilization/demobilization	3%	5%		100,000	0%		-
	Insurance and taxes	1%	2%		40,000	0%		-
Markup		**12%**	**15%**	**<Stated as % of total**	**406,000**	**12%**		**50,000**
	Risk	3%	5%		100,000	50%		50,000
	Home Office G&A	8%	10%	<Stated as % of Direct Cost	200,000	0%		-
	Profit	4.3%	5.3%		106,000	See below		See below
Total			**100%**		**2,626,000**	**7%**		**186,000**
Estimated Total Project Profit		**$**	**807,312**					

Acceleration cost per day		$ 18,600
I/D incentive profit per day (to be added to above Accelleration cost per day)	Profit-neutral value = $705	$ 3,000
Net I/D daily amount		**$ 21,600**
Total I/D profit incentive for period		**$ 30,000**
Total I/D amount for period		**$ 216,000**
Total I/D profit incentive as a % of Total Project profit		**3.7%**
Total RUC amount for period		**$ 350,000**
Incentivized portion		**$ 2,812,000**

Stage II

Figure 6.2: Incentive Determination Model user screen

7.0 CONCLUSION

This research discovered that I/D contracting has been used in a limited fashion at ODOT, usually instituted through the efforts of a few individuals who used strong engineering judgment and experience gained from prior ODOT projects to establish the contractual parameters applied to the various projects. ODOT's prior use of I/D contracting has delivered several successful projects. ODOT has recognized that an effort – of which this research is a part – to create a more defined, written guidance would provide more consistency, especially as others within ODOT are tasked with determining whether and how to implement I/D contracts.

This research has found that I/D contracting has been studied across the nation, and that these studies have been well-summarized in various research reports. These studies provide theoretical concepts and FHWA-suggested guidelines that are useful for adoption at ODOT. However, it is clear that many of the parameters necessary for I/D contracting are subjectively determined. Methods to establish one of the parameters – the lower boundary (contractor cost of acceleration) is not well-developed.

The nationally derived processes have provided the basis for a suggested flow-model for I/D contract development. This model includes checklists of criteria to determine the appropriateness of I/D contracting and the likelihood for success.

This research presents a framework for estimating the cost and profit necessary for a contractor to accelerate a portion of a highway project. Evaluating this "lower boundary" is valuable in effectively and efficiently assigning incentives and disincentives to highway projects. A further value of this model is that it may be used as a basis for process improvement, since it provides a consistent means for establishment of incentive amounts, and the model may be improved at each iteration through actual experience.

It is acknowledged that there is much judgment applied to the empirical factors used in the model; however, those factors were created by seasoned in-house and consulting experts at ODOT, and have been used previously on other studies, such as models to forecast inflation. The reader is encouraged to experiment with the factors presented until the reader arrives at a starting point for model usage. Unfortunately, the development of factors through traditional data analysis is hampered due to the secretive nature of the highway bidding process; thus engineering judgment is appropriate.

Future research may be valuable in establishing a more refined family of factors to apply to the model. In the meantime, it is the accessible and practical model framework itself that will begin to introduce consistency and auditability to the process of establishing incentive amounts. Further, establishment of a tracking system to monitor the results of I/D projects will provide a basis for future improvements.

Incentive/Disincentive (I/D) contracting is one among many contractual, managerial, and design tools available to DOTs to encourage on-time or accelerated construction. This research provides parameters to aid in determining whether I/D contracting is appropriate on a particular project. However, this research does not provide direction as to whether I/D contracting is more appropriate than, or should be supplemented by, other methods used to ensure timely project delivery. ODOT is currently undertaking a related research project – "Alternatives to Liquidated Damages for Ensuring Project Performance and Adherence to Completion Dates" – which is evaluating the means to prioritize among time-based project techniques for a particular project.

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APPENDICES

APPENDIX A: ODOT I/D PROJECT EXPERIENCE

1. Trunnion Bridge Project			
Start Date:	1996	**Contract #**	Unknown
Contractor:	Christie Constructors	**Value:**	$2.9 M
ODOT Contact:	Frank Nelson	**Bid Type:**	Best Value
Specs in Appendix B?	No		
Other:	Probably first ODOT I/D project; see discussion in report for further description		

2. Sand Lake Road Slide			
Start Date:	1999	**Contract #**	12244
Contractor:	Wildish Standard Paving Company	**Value:**	$1.5 M
ODOT Contact:	Wildish Standard Paving Co.	**Bid Type:**	A+B
Specs in Appendix B?	Yes		
Other:	See http://www.co.tillamook.or.us/gov/pw/history/sl-rd-slide-intro.htm		

3. Spencer Creek Detour Bridge			
Start Date:	1999	**Contract #**	12297 B
Contractor:	Advanced American Diving Serv.	**Value:**	$1.8 M
ODOT Contact:	Dale Deatherage	**Bid Type:**	Design-Bid-Build
Specs in Appendix B?	Yes		
Other:	Emergency project on the Coast Highway		

4. Evans Creek Section			
Start Date:	1999	**Contract #**	12221
Contractor:	LTM, Inc.	**Value:**	$7.7 M
ODOT Contact:	Dale Deatherage	**Bid Type:**	Design Build
Specs in Appendix B?	No		
Other:	Between Grants Pass and Medford		

5. Kruse Way			
Start Date:	1999	**Contract #**	12339
Contractor:	Kiewit Pacific Co.	**Value:**	$34.3
ODOT Contact:	Marge West	**Bid Type:**	A+B
Specs in Appendix B?	No		
Other:	I-5 / Hwy 217 Interchange at Lake Oswego; see write-up in body of report for more project information.		

6. Garden Valley Blvd.-Roberts Creek			
Start Date:	2000	**Contract #**	12490
Contractor:	Huffman-Wright	**Value:**	$12.4 M
ODOT Contact:	Stuart Cobine	**Bid Type:**	Design-Bid-Build
Specs in Appendix B?	Yes		
Other:	I-5 in Roseburg		

7. Medford Viaduct			
Start Date:	2002	**Contract #**	12746
Contractor:	Wildish Standard Paving Company	**Value:**	$6.3 M
ODOT Contact:	Dale Deatherage	**Bid Type:**	A+B
Specs in Appendix B?	No		
Other:	I-5 at Medford		

8. St. Johns Bridge Rehabilitation			
Start Date:	2002	**Contract #**	12793
Contractor:	Max J. Kuney Co.	**Value:**	$31.0 M
ODOT Contact:	Dave Thompson	**Bid Type:**	A+C
Specs in Appendix B?	No		
Other:	See http://www.oregon.gov/ODOT/HWY/REGION1/StJohns/index.shtml ; incentive $20,000/day.		

9. Trout Creek Bridge Section			
Start Date:	2003	**Contract #**	12820
Contractor:	Holm II, Inc.	**Value:**	$0.3 M
ODOT Contact:	Dale Deatherage	**Bid Type:**	Design-Bid-Build
Specs in Appendix B?	Yes		
Other:	Sweet Home area; fish passage		

10. Columbia River Br. - Willamette River Br. (Unit 1) Section / I-205			
Start Date:	2003	**Contract #**	12806
Contractor:	Reed Construction	**Value:**	$14.8 M
ODOT Contact:	Dale Deatherage	**Bid Type:**	Design-Bid-Build
Specs in Appendix B?	Yes		
Other:			

11. I-84 Quarry Bridges			
Start Date:	2003	**Contract #**	12819
Contractor:	James W. Fowler Co.	**Value:**	$18.7 M
ODOT Contact:	Craig Sipp	**Bid Type:**	Design-Build
Specs in Appendix B?	Yes		
Other:	Emergency project over Grande Ronde River at La Grande		

12. I-5 McKenzie and Willamette Bridges			
Start Date:	2003	**Contract #**	12894
Contractor:	Hamilton Construction	**Value:**	$28.9 M
ODOT Contact:	Stuart Cobine	**Bid Type:**	A+B
Specs in Appendix B?	Yes		
Other:	Temporary repair and detour		

13. OR 47 Azalea St. - 2nd St.			
Start Date:	2004	**Contract #**	12952
Contractor:	Kodiak Benge Construction	**Value:**	$0.9 M
ODOT Contact:	Dale Deatherage	**Bid Type:**	Design-Bid-Build
Specs in Appendix B?	No		
Other:	At Yamhill		

14. Mt Hood to Chemult Bridges			
Start Date:	2004	**Contract #**	12990
Contractor:	Wildish Standard Paving Co.	**Value:**	$30.5 M
ODOT Contact:	Robert Burns Steven Narkiewicz	**Bid Type:**	Design-Build
Specs in Appendix B?	Yes		
Other:			

15. US 101 Cape Creek Tunnel Section			
Start Date:	2004	**Contract #**	13041
Contractor:	Kiewit Construction Co.	**Value:**	$5.0 M
ODOT Contact:	Dale Deatherage	**Bid Type:**	Design-Bid-Build
Specs in Appendix B?	Yes		
Other:			

16. Chemawa Rd. - N. Santiam Interchange			
Start Date:	2004	**Contract #**	12986
Contractor:	J.C. Compton Contractor, Inc.	**Value:**	$5.8 M
ODOT Contact:	Dale Deatherage	**Bid Type:**	Design-Bid-Build
Specs in Appendix B?	No		
Other:	At Salem		

17. I-105: Willamette River-Pacific Highway			
Start Date:	2005	**Contract #**	13061
Contractor:	Oregon Mainline Paving, LLC	**Value:**	$13.0 M
ODOT Contact:	Ann Sanders	**Bid Type:**	Design-Bid-Build
Specs in Appendix B?	Yes		
Other:			

18. I-5: N. Santiam – Kuebler Blvd. (2005)			
Start Date:	2005	**Contract #**	13181
Contractor:	Hamilton Construction Co.	**Value:**	$65.2 M
ODOT Contact:	Lou Torres	**Bid Type:**	Design-Bid-Build
Specs in Appendix B?	Yes		
Other:	In Salem; see http://www.oregon.gov/ODOT/HWY/REGION2/docs/area3/I-5_N_Santiam_Kuebler/I-5Kuebler_PIP.PDF		

APPENDIX B: SAMPLE I/D SPECIFICATIONS

SAND LAKE ROAD SLIDE

SP00198 (3-25-99)

SECTION 00198 - INCENTIVES FOR EARLY COMPLETION

Section 00198, which is not in the Standard Specifications, is included in this project by special provision.

Description

00198.00 Scope - To encourage the Contractor to complete the project early, thereby reducing economic losses to the Department, businesses and the public, the Department will pay an incentive for early completion.

00198.10 Incentive Award Amount - For each day, up to a limit of 14 days, the Contractor completes the portion of the project ahead of the scheduled completion date established in 00180.50(a), the Department agrees to pay the following:

Incentive Award of $500 per day early.

00198.20 Calculation of Incentive - The Engineer will determine the completion date of the portion of the project and compare that with the completion date established in 00180.50(a). The Contractor will receive an amount of $500 per day, as an incentive, for the number of days the portion of the project is completed early, up to a maximum of 14 days ($7,000). Any partial day will be rounded to the nearest whole day.

If the portion of the project is not complete on the completion date established in 00180.50(a), liquidated damages will be assessed as provided in 00180.50(c).

00198.30 Payment of Incentive - The Engineer will consider the amount due the Contractor for early completion as a lump sum payment for preauthorized extra work at the contract specified price above. It will be invoiced and paid separately from all other contract payments.

SPENCER CREEK DETOUR BRIDGE

SECTION 00198 - INCENTIVES AND DISINCENTIVES

Section 00198, which is not in the Standard Specifications, is included in this project by special provision.

00198.00 Scope - To encourage the Contractor to open the detour early, thereby reducing risk of traffic disruption and economic losses to businesses and the public, the Department will pay an incentive for early opening of the detour or assess a disincentive for late opening of the detour.

00198.01 Definitions:

Open(ing of) the detour – Occurs when the Oregon Coast Highway (US 101) traffic is moved off of the existing Spencer Creek Bridge onto the new detour bridge such that normal operating traffic flow and speed are established and maintained.

00198.10 Early Completion Incentive Award - Upon early opening of the detour, the Department agrees to pay an incentive of $10,000 per day for each day following actual completion and acceptance of the work until the scheduled date of opening of the detour.

The maximum award will not be greater than $100,000.

00198.20 Payment of Incentive - The Engineer will consider the amount due the Contractor for early opening of the detour as a lump sum payment for pre-authorized extra work at the contract price specified above. It will be invoiced and paid separately from all other contract payments.

00198.30 Late Completion Disincentive - The Department will assess the Contractor a disincentive of $10,000 per day for every day work continues beyond scheduled date of opening of the detour stated in 00180.50(a), but not beyond the final completion date shown in 00180.50(b).

The maximum disincentive will not be greater than $100,000.

GARDEN VALLEY BLVD.-ROBERTS CREEK

SECTION 00198. INCENTIVES AND DISINCENTIVES

Section 00198, which is not in the Standard Specifications, is included in this project by special provision.

00198.00 Scope- The Department will pay an incentive for early completion of construction stages according to the formulas below. The contractor agrees that the Department will, for late completion, reduce the amount payable under the contract according to the formulas below.

00198.10. Early Completion Incentive Award.- The Department agrees to pay $10,000 per day, upon early completion of stages identified in a) b) and c) of 00180.50, for each day following actual completion and acceptance of the work involved in that stage until the expiration of contract is established for that stage.

00198.20. Payment of Incentive. Each payment will be invoiced and paid separately from all other contract payments. Incentive payments for early completion of a stage may be billed, and will be paid, only after completion and acceptance by the Department of the work on that stage.

00198.30. Late Completion Disincentive. The Department will reduce the amount payable by $10,000 per day for late completion of stages identified in a), b) and c) of 00180.50, for each day work continues beyond the expiration of the contract time established for that stage until completion and acceptance of the work involved in that stage.

00198.40. Net Value of Incentives and Reductions. The net change to the contract amount payable under this contract due to the provisions of this section shall not exceed $300 000.

Nothing in this section alters or otherwise affects any possible assessment of liquidated damages for final completion under 00180.85.

TROUT CREEK BRIDGE SECTION

SECTION 00198 - INCENTIVES FOR EARLY COMPLETION

Section 00198, which is not in the Standard Specifications, is included in this project by special provision.

00198.00 Scope - To encourage the Contractor to complete the work specified in 00180.50(h-1) and (h-2) within a shorter time span than specified, thereby reducing expenses to the Department and economic losses to businesses and the public, the Department will pay to the Contractor an incentive award for early completion of the work specified in 00180.50(h-1) and (h-2).

00198.10 Incentive Award Amount:

(a) Interim Completion Duration In-Water Work - If the Contractor completes all In-Water work (Riprap Blanket and Toe Detail, shown on sheet 2A) to be done under the Contract before the elapse of the three calendar days as provided in 00180.50(h-1), the Department agrees to pay the Contractor an incentive award of $10,000 per calendar day from the actual day of completion to the end of the three calendar days. Any partial day will be rounded to the nearest whole day.

(b) Interim Completion Date Bridge Open to Single-Lane Traffic - If the Contractor completes all installation of prestressed deck slabs, bridge rail, precast end panels, and traffic restored to one lane work to be done under the Contract before April 28, 2003 the Department agrees to pay the Contractor an incentive award of $10,000 per calendar day from the actual day of completion to April 28, 2003. Any partial day will be rounded to the nearest whole day.

00198.20 Payment of Incentive - Each payment will be invoiced and paid separately from all other contract payments. Incentive payments for early completion of a stage may be billed, and will be paid, only after completion and acceptance by the Department of the work on that stage.

COLUMBIA RIVER BR. - WILLAMETTE RIVER BR. (UNIT 1) SECTION / I-205

(Complex Specifications)

(b) Concurrent Assessment of Disincentives - There is no overall limit on the amount of disincentives that may be assessed; however, disincentives will not be assessed concurrently under the combination of Interim Completion Dates under (a-1) and (a-2) above. The maximum disincentive assessed under any circumstances will not exceed $10,000 per calendar day.

(c) Incentive for Early Completion See Section 00198.

SECTION 00198 - INCENTIVES FOR EARLY COMPLETION

Section 00198, which is not in the Standard Specifications, is included in this project by special provision.

00198.00 Scope - To encourage the Contractor to complete the work specified in 00180.50(h-1) and (h-2) within a shorter time span than specified, thereby reducing expenses to the Department and economic losses to businesses and the public, the Department will pay to the Contractor an incentive award for early completion of the work specified in 00180.50(h-1) and (h-2).

00198.10 Incentive Award Amount:

(a) Interim Completion Date -UPRR O'xing - If the Contractor completes all microsilica overlay, deck joint, terminal anchor joint, removal of associated staging, and traffic restored to original configuration work to be done under the Contract for the northbound and southbound UPRR O'Xing structures before June 30, 2003, the Agency agrees to pay the Contractor an incentive award of $10,000 per calendar day from the actual day of completion to June 30, 2003, up to a maximum of 25 calendar days. Any partial day will be rounded to the nearest whole day.

(b) Interim Completion Date - Springwater Corridor, Mt. Scott, SE 92nd Ave. - If the Contractor completes all microsilica overlay, deck joint, terminal anchor joint, removal of associated staging, and traffic restored to original configuration work to be done under the Contract for the northbound and southbound structures located at Springwater Corridor, Mt. Scott and SE 92nd Avenue before July 31, 2003, the Agency agrees to pay the Contractor an incentive award of $3,000 per calendar day from the actual day of completion to July 31, 2003, up to a maximum of 25 calendar days. Any partial day will be rounded to the nearest whole day.

00198.20 Maximum Incentive Award Amount - The maximum incentive award to be paid under the Contract will not exceed $250,000 under 00198.10(a) and $75,000 under 00198.10(b) for a total possible incentive award amount under the Contract of $325,000. Any partial day will be rounded to the nearest whole day.

00198.30 Payment of Incentive - The Engineer will consider the amount due the Contractor for early completion as a lump sum payment for preauthorized extra work at the Contract specified price above. It will be invoiced and paid separately from all other Contract payments.

I-84 QUARRY BRIDGES

End of Contract Time

When the contractor believes that all work, except minor corrective work and clean-u, has been completed, the Contractor may request in writing that the engineer conduct an inspection. The Engineer will respond to such request within twenty-four hours, and will, as soon as practicable thereafter, perform an inspection to determine whether the work is complete. Upon determining that all work, except minor corrective work and clean-up, has been completed, the Engineer will issue Second Notification. The date of Second Notification will be the date on which the contractor requested the inspection, provided the Engineer determines that the work has been satisfactorily completed.

Failure to Complete on time and Liquidated Damages

Liquidated damages of $2,800 per calendar day will be assessed for failure to complete the work within 90 calendar days of the contract completion date. Liquidated damages will be assessed beginning on the 91st calendar day after the contract completion date. Liquidated damages will not be assessed concurrently with the disincentive.

Incentive

An incentive, not to exceed $360,000, will be available for completion of the Project prior to the Contract Completion Date.

The "Daily Incentive Amount" will be $4,000 per calendar day.

The incentive earned will be the daily incentive amount times the number of calendar days by which the date of Second Notification precedes the Contract Completion Date, but in no case will the incentive exceed $360,000.

The amount of any incentive earned will be added to the next progress payment due to the contractor.

Disincentive A disincentive, not to exceed $ 360,000, will be incurred for failure to complete the project by the Contract Completion Date.

The "Daily Disincentive Amount" will be $4,000 per calendar day.

The disincentive assessed will be the daily disincentive amount times the number of calendar days by which the Contract Completion Date precedes the date of Second Notification, but in no case will the disincentive exceed $ 360,000.

The amount of any disincentive incurred will be withheld from the next progress payment or payments, as they become due, until the disincentive amount has been paid.

I-5 MCKENZIE AND WILLAMETTE BRIDGES

SECTION 00198 INCENTIVES FOR EARLY COMPLETION

Section 00198, which is not a Standard Specification, is included in this Project by Special Provision.

00198.00. Scope- To encourage the Contractor to complete all work to be done under the Contract, except for the removal of all work bridges and caissons, landscaping and plant establishment, within a shorter time span than proposed by the Contractor, thereby reducing expenses to the Agency and economic losses to businesses and the public, the Agency will pay to the Contractor an incentive award for early completion.

00198.10. Incentive Award:

a) Determination of Incentive Award Date – The "Incentive Award Date" will be determined by adding the number of calendar days proposed by the contractor as component B to September 19, 2003.

b) Incentive Award Amount- The amount of the incentive award will be $20,000 per calendar day, up to a maximum of 100 calendar days, counted from the actual date of completion to the Incentive Award Date determined in a) above. Any partial day will be rounded to the nearest whole day. The maximum incentive award to be paid under the contract will not exceed $2,000,000.

00198.20. Payment of Incentive- Each payment will be invoiced and paid separately from all other contract payments. Incentive payments for early completion may be billed, and will be paid, only after completion and acceptance by the agency of the work.

MT HOOD TO CHEMULT BRIDGES

Interim Completion Date - Complete all Work required to carry one lane of non-restricted continuous traffic in each direction on permanent replacement Structures or on temporary (not existing) Structures no later than May 1, 2005 (the "Interim Completion Date").

Incentive - An incentive, not to exceed $150,000, will be available for completion of the Project prior to the Interim Completion Date (see 00180.50(a-1)).

The "Daily Incentive Amount" will be $5,000 per Calendar Day.

The incentive earned will be the Daily Incentive Amount times the number of Calendar Days by which the date of completion of all Work required to carry one lane of non-restricted continuous traffic in each direction on permanent replacement Structures or on temporary (not existing) Structures precedes the Interim Completion Date, but in no case will the incentive exceed $150,000.

The amount of any incentive earned will be added to the next progress payment due the Contractor.

Provided that the incentive will not be available in the event Contractor or any Sub is cited for safety infractions, has been involved in a hazardous materials incident, environmental contamination incident, or is in material breach of any other provision of the contract?

Disincentive - A disincentive, not to exceed $150,000, will be incurred for failure to complete the Project by the Interim Completion Date.

The "Daily Disincentive Amount" will be $5,000 per Calendar Day.

The disincentive assessed will be the Daily Disincentive Amount times the number of Calendar Days by which the Interim Completion Date precedes the date of completion of all Work required to carry one lane of non-restricted continuous traffic in each direction on permanent replacement Structures or on temporary (not existing) Structures, but in no case will the disincentive exceed $150,000.

The amount of any disincentive incurred will be withheld from the next progress payment or payments, as they become due, until the disincentive amount has been paid.

US 101 CAPE CREEK TUNNEL SECTION

SECTION 00120 - BIDDING REQUIREMENTS AND PROCEDURES

Comply with Section 00120 of the Standard Specifications supplemented and/or modified as follows:

Add the following subsections:

00120.01 Special Prequalification - Only those bidders who were notified that they were accepted and who meet the special prequalification requirements for this project may submit bids. The special prequalification requirements were advertised on June 3, 2004. Any bid submitted by firms not accepted under this special prequalification will be rejected.

00180.50 Contract Time to Complete Work - Replace subsection 00180.50(a), 00180.50 (c) and 00180.50(d) with the following:

(a) General - Complete all Work to be done under the Contract within the "Contract Time" described in 00180.50(h). For purposes of 00180.50(c and h-1) and 00180.86(a), Full Tunnel Closure shall be considered holding of vehicles for more than 20 minutes, or otherwise not complying with Section 00220.02.

(c) Beginning of Contract Time – Contract time shall begin on September 12, 2004. Full Tunnel Closure before September 12, 2004 will not be allowed.

(d) Recording Contract Time - All Contract Time will be recorded and charged to the nearest full day.

(g) End of Contract Time - In the bullet that begins "Submittals, including without...", replace "00170.70(e)" with "00170.70(b)".

Add the following subsections:

(h) Contract Time Dates and Durations - For purposes of 00180.50(h-1, 2 and 3), 00180.86 and 00198, to be considered complete, the Work shall have been finished and completed to the satisfaction of the Engineer. The completion dates allowed are given in the following paragraphs (1), (2) and (3):

(1) Interim Completion Date - Complete all Work to be done under the Contract that requires a Full Tunnel Closure not later than December 17, 2004. See Section 00198 for Incentive and 00180.86 for Disincentive.

(2) Interim Completion Date - Complete all Work to be done under the Contract except durable striping not later than January 7, 2005.

(3) Final Completion Date - Complete all Work to be done under the Contract not later than May 31, 2005.

00180.85(b) Liquidated Damages - Add the following:

There are three daily amounts of liquidated damages to be assessed on this Project as follows:

Liquidated damages for failure to complete the Work on time required by 00180.50(h-1) will be $1,300 per Calendar Day* and will be assessed beginning when the maximum disincentive has been assessed under 00180.86. Liquidated damages for failure to complete the Work on time required by 00180.50(h-2) will be $1,300 per Calendar Day*. Liquidated damages for failure to complete the Work on time required by 00180.50(h-3) will be $1,300 per Calendar Day*. If more than one daily amount of liquidated damages become concurrently payable under this 00180.85(b) because the Contractor is concurrently out of compliance with more than one of the completion times in 00180.50(h), liquidated damages will be assessed at $1,300 per Calendar Day*.

> * Calendar Day amounts are applicable when the Contract time is expressed on the Calendar Day or fixed date basis.

00180.86 Disincentive for Late Completion - Add the following subsection:

(a) Interim Completion Date - For each Calendar Day that any or all Work to be done under the Contract which requires a Full Tunnel Closure remains uncompleted after December 17, 2004, the Agency will assess a disincentive of $5,000 per Calendar Day, up to a maximum of 10 Calendar Days, to be deducted from the next regular payment due the Contractor.

(b) Concurrent Assessment of Disincentives - The maximum disincentive assessed under any circumstances will not exceed $50,000. Disincentives will not be assessed concurrently with liquidated damages. For any time the Contractor is out of compliance with 00180.50(h-1), only the disincentive of 00180.86 will be assessed until the maximum disincentive has been reached, or Agency otherwise ceases to assess the disincentive, at which time the applicable liquidated damages under 00180.85(b) will be assessed.

(c) Incentive for Early Completion - See Section 00198.

SECTION 00198 INCENTIVES FOR EARLY COMPLETION

Section 00198, which is not a Standard Specification, is included in this Project by Special Provision.

00198.00 Scope –

(a) General - For purposes of 00198, Full Tunnel Closure shall be considered holding of vehicles for more than 20 minutes, or otherwise not complying with Section 00220.02.

(b) Incentive for Early Completion - To encourage the Contractor to complete all Work to be done under the Contract requiring a Full Tunnel Closure before December 17, 2004, thereby reducing expenses to the Agency and economic losses to businesses and the public, the Agency will pay to the Contractor an incentive award for early completion.

00198.10 Incentive Award - The amount of the incentive award for early completion will be $5,000 per Calendar Day, up to a maximum of 10 Calendar Days, counted from the actual date of completing work prior to December 17, 2004 (see 00180.50(h-1)). Any partial day will be rounded to the nearest full day. The maximum incentive award to be paid under the Contract will not exceed $50,000.

00198.20 Payment of Incentive - Each payment will be paid separately from all other contract payments. Incentive payments for early completion will be paid only after completion and acceptance by the Agency.

00220.40(e) Lane Restrictions – After September 11th, full closure of the tunnel will be allowed between 8:00 p.m. and 6:00 a.m., and one-lane closure will be allowed 6:00 a.m. to 8:00 p.m. In addition, do not close any traffic lanes between:

- 3:00 p.m. on Fridays and 8:00 p.m. on Sundays.
- Noon on the day preceding legal holidays or holiday weekends and midnight on legal holidays or the last day of holiday weekends, except for Thanksgiving, when no lanes may be closed between noon on Wednesday and midnight on the following Sunday.

For the purposes of this section, legal holidays are as follows:

- New Year's Day on January 1
- Memorial Day on the last Monday in May
- Independence Day on July 4
- Labor Day on the first Monday in September
- Thanksgiving Day on the fourth Thursday in November
- Christmas Day on December 25

When a holiday falls on Sunday, the following Monday shall be recognized as a legal holiday. When a holiday falls on Saturday, the preceding Friday shall be recognized as a legal holiday.

Roadways shall be free of barricades or other objects and all lanes opened to traffic during all the restrictive periods listed above.

00220.40(f) Liquidated Damages - Lane closures not in compliance with the limits listed in 00220.40(e) would inconvenience the traveling public and would be a cost to the Agency.

It is impractical to determine the actual damages which the Agency would sustain in the event a traffic lane is closed. Therefore, the Contractor shall pay to the Agency, not as a penalty, but as liquidated damages, $500 per 15 minutes, or any portion thereof, per lane, for any lane closure not in compliance with the limits listed in 00220.40(e). In addition to the liquidated damages, any added cost for traffic control measures, including flagging, required to maintain the lane closures beyond the permitted time limits, shall be at the Contractor’s expense. The required traffic control measures will be as determined by the Engineer.

The Engineer will determine when it is safe to reopen a lane to traffic. Assessment of liquidated damages will stop when the lane has been safely reopened. Any liquidated damages assessed under these provisions will be in addition to those under 00180.85(b).

I-105: WILLAMETTE RIVER-PACIFIC HIGHWAY

Time Line:

The contract is planned to bid in November 2004 with construction starting first quarter 2005.

Construction work and paving is scheduled to begin as early as March and complete by the end of October 2005.

Construction work with major traffic impacts is expected to take 66 days and nights.

Incentive/disincentive will be offered to the contractor in an effort to reduce the 66 days of work.

Impacts of the Work:

Work will require nighttime lane closures with several weekend closures of various intersection legs.

(Weekend closure to be defined independently for each leg and could include more than Saturday and Sunday).

Mainline work (2 lanes eastbound, 2 lanes westbound and median) will continue around the clock and includes removal of the concrete panels.

2005 metro area construction projects are being coordinated to reduce congestion but increase in travel times and travel delays are anticipated.

Final interchange configurations will remain the same.

Trees and vegetation will be removed along I-105 to allow for safety improvements, which include the construction of auxiliary lanes and standard shoulders.

SECTION 00180 - PROSECUTION AND PROGRESS

Comply with Section 00180 of the Standard Specifications supplemented and/or modified as follows:

00180.40 **Limitation of Operations** - Add the following at the end of this Subsection:

(c) **Specific Limitations** - Limitations of operations specified in these Special Provisions include, but are not limited to, the following:

Limitations	Subsection
Cooperation with Utilities	00150.50

Interim Completion Time 00180.50
Final Completion Time 00180.50
Traffic Restrictions 00220.40
Special Events 00220.40

Work described in 00180.50(h-1), (h-2), (h-3), (h-4), (h-5) and (h-6) shall commence not earlier than April 1, 2005. For purposes of 00180.40(d), 00180.50(h), 00180.85(b), 00180.86, and 00198, “Calendar Day” shall mean any day shown on the calendar, beginning and ending at 6:00 a.m.

Complete foundation work for the luminaries and sign bridges prior to the start of Work described in 00180.50(h-1), (h-2), (h-3), (h-4), (h-5) and (h-6). Complete sign foundation work at 11+300 prior to construction of gabion wall.

Complete earthwork, aggregate base, 250 mm base course paving , concrete barrier installation, temporary striping, and lanes open to traffic for the auxiliary lanes and shoulders prior to the start of Work described in 00180.50(h-1), (h-2), (h-3), (h-4), (h-5) and (h-6).

Be aware of and subject to schedule limitations in the Standard Specifications that are not listed in this Subsection.

Add the following subsection:

00180.40(d) Construction Limitations - The following construction limitations apply.

(1) The Contractor will be permitted to close the "Qw" Line from Sta. 0+100 to Sta. 1+451.5 no longer than 8 consecutive Calendar Days commencing at 6:00 a.m. on the first such day. This closure shall not occur concurrently with closures defined in 00180.40(d-2), 00180.40(d-3), 00180.40(d-4) and 00180.40(d-5).

(2) The Contractor will be permitted to close the "Qe" Line from Sta. 0+100 to Sta. 1+449.239 no longer than 8 consecutive Calendar Days commencing at 6:00 a.m. on the first such day. This closure shall not occur concurrently with closures defined in 00180.40(d-1), 00180.40(d-3), 00180.40(d-4) and 00180.40(d-5).

(3) The Contractor will be permitted to close the following sections no longer than 3 consecutive Calendar Days commencing on a Friday at 6:00 a.m. This closure shall not occur concurrently with closures defined in 00180.40(d-1) or 00180.40(d-2).

These sections shall be closed concurrently:

(a) Westbound from "L" Sta. 10+558 to Sta. 11+042.

(b) Eastbound from "L" Sta. 10+558 to Sta. 11+100.

(c) Ramp from "E" Sta. 0+100 to Sta. 0+273.

(d) Ramp from "F" Sta. 0+000 to Sta. 0+233.

(4) The Contractor will be permitted to close the section from "L" Sta. 11+540 to Sta. 12+720, Stage 2, Phase 2 no longer than 12 consecutive Calendar Days commencing at 6:00 a.m. on the first such day. This closure shall not occur concurrently with closures defined in 00180.40(d-1) or 00180.40(d-2).

(5) The Contractor will be permitted to close the section from "L" Sta. 11+540 to Sta. 12+720, Stage 2, Phase 3 no longer than 12 consecutive Calendar Days commencing at 6:00 a.m. on the first such day. This closure shall not occur concurrently with closures defined in 00180.40(d-1) or 00180.40(d-2).

00180.41 Project Work Schedules - Modify this Subsection as follows:

(a) Type "A" Schedule - Replace this Subsection with the following:

(a) Type "C" Schedule - The Contractor shall submit Project Work schedules as outlined below, to plan, coordinate, and control the progress of construction.

(1) Initial Schedule - Ten workdays prior to the preconstruction conference, the Contractor shall provide to the Engineer four copies of a time-scaled bar chart Project Work schedule showing:

- The priority and interdependence of all major portions of the work;
- Expected beginning and completion date of each activity, including all staging; and
- Elements of the traffic control plan as required under 00225.05.

A logic diagram and a time-scaled bar chart will be acceptable in lieu of a time-scaled logic diagram.

The initial schedule shall show all Work intended for the first 60 days of the Contract to the level of detail described in (2) below.

(2) Detailed Schedule - In addition to the above requirements, and within 30 Calendar Days after the Notice to Proceed, the Contractor shall provide the Engineer four copies of a detailed time-scaled critical path method (CPM) network schedule and computer analysis printout, both clearly indicating the critical path. The first submitted detailed schedule shall also contain a listing of the quantity of Work for each activity, when appropriate, in common units of measure.

- Construction activities;
- Submittal and approval of Material samples and shop drawings;
- Procurement of critical Materials;
- Fabrication, installation, and testing of special Material and Equipment; and
- Duration of Work, including completion times of all stages and their subphases.

The activities shall be separately identifiable by coding or use of sub-networks or both. The duration of each activity shall be verifiable by manpower and equipment allocation, in common units of measure, or by delivery dates and shall be justifiable by the Contractor upon the request of the Engineer.

Detailed sub-networks will include all necessary activities and logic connectors to describe the Work and all restrictions on it. In the restraints, include those activities from the project schedule that initiated the sub-network as well as those restrained by it.

The time scale used on the Contractor's time-scaled CPM network schedule shall be appropriate for the duration of the activities and the Project duration. The time scale shall be in normal workdays, defined as every day except Saturday, Sunday and legal holidays, with calendar dates identified no less than the first and midpoint of each calendar month. The smallest unit shown shall be one day. The network shall show the length of the activity or part scaled to accurately represent the number of normal workdays scheduled. Distinct symbols or graphics shall be used to show multiple shift, holiday, or weekend work.

The schedule network drawing(s) shall include a title block showing the Contract name and number, Contractor's name, date of original schedule, and all update dates; and a legend containing the symbols used, their definitions, and the time scale, shown graphically. To ensure readability the drawings shall be on a reasonable size of paper up to a maximum of 915 mm x 915 mm (36 inch x 36 inch), using multiple sheets when needed.

The Contractor shall include a tabulation of each activity in the computer mathematical analysis of the network diagram. The following information represents the minimum required for each activity:

- Event (node) number(s) for each activity;
- Activity description;
- Original duration of activities (in normal workdays);
- Estimated remaining duration of activities (in normal workdays);
- Earliest start date or actual start date (by calendar date);
- Earliest finish date or actual finish date (by calendar date);
- Latest start date (by calendar date);
- Latest finish date (by calendar date); and
- Slack or float time (in workdays).

Computer print-outs shall consist of at least a node sort and an "early start/total-float" sort.

Within seven workdays after submission of the Project schedule the Engineer and the Contractor shall meet to review the Project schedule as submitted. Within 10 days of the meeting, the Contractor shall resubmit to the Engineer four copies of the Project schedule, including required revisions.

The approved Project schedule shall represent all Work, as well as the planned sequence and time for the Work. Review of this and subsequent schedules by the Engineer shall not relieve the Contractor of responsibility for timely and efficient execution of the Contract.

(b) **Review by the Engineer** - Replace this Subsection with the following:

(b) Review and Reporting - The Project Work schedule may require revision as the Work progresses. Therefore, the Contractor shall monitor and when necessary revise the Project Work schedule as follows:

(1) Review with the Engineer - The Contractor shall perform ongoing review of the Project Work schedule and progress of the Work with the Engineer. If the Engineer or the Contractor determines that the Project Work schedule no longer represents the Contractor's own plans or expected time for the Work, a meeting shall be held between the Engineer and the Contractor. At this meeting, the Contractor and the Engineer shall review Project events and any changes for their effect on the Project Work schedule. After any necessary action has been agreed upon, the Contractor shall make required changes to the Project Work schedule.

The Contractor shall collect information on all activities worked on or scheduled to be worked on during the previous report period, including shop drawings, Material procurement, and Contract Change Orders that have been issued. Information shall include commencement and completion dates on activities started or completed, or if still in progress, the remaining time duration.

The Contractor shall develop detailed sub-networks to incorporate changes, Additional Work, and Extra Work into the Project Work schedule. Detailed sub-networks shall include all necessary activities and logic connectors to describe the Work and all restrictions on it. The restraints shall include those activities from the Project Work schedule that initiated the sub-network as well as those restrained by it.

The Contractor shall evaluate this information and compare it with the Contractor's project schedule. If necessary, the Contractor shall make an updated bar chart schedule to incorporate the effect changes may have on the Project completion time(s). For any activity that has started, the Contractor shall add a symbol to show the actual date the activity started and the number of normal workdays remaining until completion. For activities that are finished, a symbol shall be added to show the actual date. The Contractor shall submit four copies of the updated bar chart to the Engineer within seven days after the progress meeting, along with a progress report as required by (2) below.

(2) Progress Report - The Contractor shall submit a progress report to the Engineer with each monthly update of the Project Work schedule. The report shall include the following:

- Sufficient narrative to describe the past progress, anticipated activities, and stage Work;
- A description of any current and expected changes or delaying factors and their effect on the construction schedule; and
- Proposed corrective actions.

(c) Substitution of Type "B" or "C" Schedule - Delete this Subsection.

00180.42 Preconstruction Conference - Add the following paragraphs:

Before meeting with the Engineer for the preconstruction conference, hold a group utilities scheduling meeting with representatives from the utility companies involved with this project. Incorporate the utilities time needs into the Contractor's schedule submitted at the preconstruction conference.

Before meeting with the Engineer for the preconstruction conference, hold a group meeting with the trucking industry, MCTD, and the emergency service providers (fire, ambulance, and police) to discuss traffic control.

00180.50(d) Recording Contract Time - Replace the first paragraph with the following.

00180.50(d) Recording Contract Time - All contract time will be recorded and charged to the nearest day. Any portion of work performed within a day will be counted as one full day. For purposes of the consecutive Calendar Day periods provided in 00180.50(h-1) through (h-6), the recording of the elapse of consecutive Calendar Days will begin on the Calendar Day the Contractor begins any of the Work defined in the applicable paragraph under 00180.50(h-1) through (h-6).

00180.50(g) End of Contract Time - In the bullet that begins "Submittals, including without...", replace "00170.70(e)" with "00170.70(b)".

Add the following Subsection:

00180.50(h) Contract Time – For purposes of 00180.50, 00180.85, 00180.86, and 00198, to be considered complete the Work shall have been finished and completed to the satisfaction of the Engineer. The completion dates or durations allowed for completion of the Work under this Contract are given in the following paragraphs:

(1) Complete all concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration for the "L", "Qw", "Qe", "A", "E", and "K" Lines Work to be done under the Contract before the elapse of 66 consecutive Calendar Days, and not later than August 1, 2005.

(2) Complete concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration on the "Qw" Line from Sta. 0+100 to Sta. 1+451.5 Work to be done under the Contract before the elapse of 8 consecutive Calendar Days. The 8 consecutive Calendar Days must occur within the 66 consecutive Calendar Day duration provided in 00180.50(h-1).

(3) Complete all concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration on the "Qe" Line from Sta. 0+100 to Sta. 1+449.239 Work to be done under the Contract before the elapse of 8 consecutive Calendar Days. The 8 consecutive Calendar Days must occur within the 66 consecutive Calendar Day duration provided in 00180.50(h-1).

(4) Complete all concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration on the following sections Work to be done under the Contract before the elapse of 3 consecutive Calendar Days commencing on a Friday. The 3 consecutive Calendar Days must occur within the 66 consecutive Calendar Day duration provided in 00180.50(h-1).

All sections shall be completed within the same 3 consecutive Calendar Day period:

(a) Westbound from "L" Sta. 10+558 to Sta. 11+042.

(b) Eastbound from "L" Sta. 10+558 to Sta. 11+100.

(c) Ramp from "E" Sta. 0+100 to Sta. 0+273.

(d) Ramp from "F" Sta. 0+000 to Sta. 0+233.

(5) Complete all concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration on the "L" Line, including shoulders and auxiliary lanes, necessary to maintain one lane of traffic over Coburg Road overpass and Country Club Road overpass in both easterly and westerly directions, and the cross-over to the auxiliary lanes, from Sta. 11+540 to Sta. 12+720, Stage 2, Phase 2 Work to be done under the Contract before the elapse of 12 consecutive Calendar Days. The 12 consecutive Calendar Days must occur within the 66 consecutive Calendar Day duration provided in 00180.50(h-1).

(6) Complete all concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration on the "L" Line, including shoulders and auxiliary lanes, necessary to maintain one lane of traffic over Coburg Road overpass and Country Club Road overpass in both easterly and westerly directions, and the cross-over to the auxiliary lanes, from Sta. 11+540 to Sta. 12+720, Stage 2, Phase 3 Work to be done under the Contract before the elapse of 12 consecutive Calendar Days. The 12 consecutive Calendar Days must occur within the 66 consecutive Calendar Day duration provided in 00180.50(h-1).

(7) Complete all Work to be done under the Contract not later than November 30, 2005.

00180.85(b) Liquidated Damages - Add the following paragraphs:

The daily amount of liquidated damages assessed for failure to complete all Work on time required by 00180.50(h-1) will be $1,600 per Calendar Day. The daily amount of liquidated damages assessed for failure to complete all Work on time required by 00180.50(h-7) will be $2,000 per Calendar Day. If liquidated damages become payable concurrently under the combination of the failure to complete all Work under both 00180.50(h-1) and (h-7), the daily amount of liquidated damages will be assessed at $2,000 per Calendar Day.

Liquidated damages will not be assessed concurrently with a disincentive assessed according to 00180.86, instead, for any time that liquidated damages under 00180.85(b) and disincentive(s) under 00180.86 could be assessed concurrently, only the applicable disincentive(s) of 00180.86 will be assessed.

* Calendar Day amounts are applicable when the Contract time is expressed on the Calendar Day or fixed date basis.

00180.86 Disincentive for Late Completion - The Agency will assess the Contractor disincentives as follows:

(a-1) Interim Completion Date - - For each Calendar Day after the elapse of the 66 consecutive Calendar Days or August 1, 2005, provided in 00180.50(h-1), whichever occurs first, that concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration Work to be done under the Contract for the "L", "Qw", "Qe", "A", "E", and "K" Lines to be done under the Contract remains uncompleted, the Agency will assess a disincentive of $35,000 per Calendard Day, up to a maximum of 14 Calendar Days, to be deducted from the next regular payment due the Contractor.

(a-2) Interim Completion Duration - "Qw" Line - For each Calendar Day after the elapse of the 8 consecutive Calendar Days provided in 00180.59(h-2) that concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration on the "Qw" Line from Sta. 0+100 to Sta. 1+451.5 Work to be done under the Contract remains uncompleted, the Agency will assess a disincentive of $7,500 per Calendar Day, to be deducted from the next regular payment due the Contractor.

(a-3) Interim Completion Duration - "Qe" Line - For each Calendar Day after the elapse of the 8 consecutive Calendar Days provided in 00180.50(h-3) that concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration on the "Qe" Line from Sta. 0+100 to Sta. 1+449.239 Work to be done under the Contract remains uncompleted, the Agency will assess a disincentive of $7,500 per Calendar Day, to be deducted from the next regular payment due the Contractor.

(a-4) Interim Completion Duration - "L", "E", and "F" Lines - For each Calendar Day after the elapse of the 3 consecutive Calendar Days provided in 00180.50(h-4) that concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration on the following sections Work to be done under the Contract remains uncompleted, the Agency will assess a disincentive of $7,500 per Calendar Day, to be deducted from the next regular payment due the Contractor. All sections shall be completed within the same 3 consecutive Calendar Day period.

(1) Westbound from "L" Sta. 10+558 to Sta. 11+042.

(2) Eastbound from "L" Sta. 10+558 to Sta. 11+100.

(3) Ramp from "E" Sta. 0+100 to Sta. 0+273.

(4) Ramp from "F" Sta. 0+000 to Sta. 0+233.

(b) Concurrent Assessment of Disincentives - There is no overall limit on the amount of disincentives that may be assessed, provided, however, that disincentives under 00180.86(a-1) above will be limited to 14 Calendar Days ($490,000 total). Disincentives will be assessed concurrently under combinations of Interim Completion Dates or Interim Completion Durations under 00180.86(a-1), (a-2), (a-3), and (a-4) above. The maximum disincentive assessed under any circumstances for any given Calendar Day will not exceed $50,000 per day. Disincentives will not be assessed concurrently with liquidated damages under 00180.85(b), instead, for any time that liquidated damages under 00185.85(b) and disincentive(s) under 00180.86 could be assessed concurrently, only the applicable disincentive(s) under 00180.86 will be assessed, until the maximum disincentive has been reached (if applicable), or Agency otherwise ceases to assess the disincentive(s), at which time the applicable liquidated damages under 00180.85(b) will be assessed.

(c) Incentive for Early Completion See Section 00198.

SECTION 00198 - INCENTIVES FOR EARLY COMPLETION

Section 00198, which is not a Standard Specification, is included in this Project by Special Provision.

00198.00 Scope - To encourage the Contractor to complete the Work specified in 00180.50(h-1), (h-2), (h-3), and (h-4), within a shorter time span than specified, thereby reducing expenses to the Agency and economic losses to businesses and the public, the Agency will pay to the Contractor an incentive award for early completion.

00198.10 Incentive Award Amount:

(a-1) Interim Completion Date - "L" Line - If the Contractor completes all concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration for the "L", "Qw", "Qe", "A", "E", and "K" Lines Work to be done under the Contract before the elapse of the 66 consecutive Calendar Days or August 1, 2005, provided in 00180.50(h-1), whichever occurs first, the Agency agrees to pay the Contractor an incentive award of $35,000 per Calendar Day from the date of actual completion of the Work to August 1, 2005 or the 66 Calendar Days less the number of those Calendar Days that elapsed before actual completion of the Work, whichever is less, up to a maximum of 14 Calendar Days. Any partial day will be counted as a whole day.

(a-2) Interim Completion Duration - "Qw" Line - If the Contractor completes all concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration on the "Qw" Line from Sta. 0+100 to Sta. 1+451.5 Work to be done under the Contract before the elapse of the 8 consecutive Calendar Days provided in 00180.50(h-2), the Agency agrees to pay the Contractor an incentive award of $7,500 per Calendar Day from the date of actual completion of the Work to the end of said 8 consecutive Calendar Day period. Any partial day will be counted as a whole day.

(a-3) Interim Completion Duration - "Qe" Line - If the Contractor completes all concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration on the "Qe" Line from Sta. 0+100 to Sta. 1+449.239 Work to be done under the Contract before the elapse of the 8 consecutive Calendar Days provided in 00180.50(h-3), the Agency agrees to pay the Contractor an incentive award of $7,500 per Calendar Day from the date of actual completion of the Work to the end of said 8 consecutive Calendar Day period. Any partial day will be counted as a whole day.

(a-4) Interim Completion Duration - "L", "E", and "F" Lines - If the Contractor completes all concrete median barrier removal, concrete pavement removal, subgrade stabilization, subbase and base aggregate placement, base and wearing course paving, temporary striping, and all lanes open to traffic in its final configuration on the following sections Work to be done under the Contract before the elapse of the 3 consecutive Calendar Days provided in 00180.50(h-4), the Agency agrees to pay the Contractor an incentive award of $7,500 per Calendar Day from the date of actual completion of the Work to the end of said 3 consecutive Calendar Day period. Any partial day will be counted as a whole day. All sections shall be completed within the same 3 consecutive Calendar Day period:

(1) Westbound from "L" Sta. 10+558 to Sta. 11+042.
(2) Eastbound from "L" Sta. 10+558 to Sta. 11+100.
(3) Ramp from "E" Sta. 0+100 to Sta. 0+273.
(4) Ramp from "F" Sta. 0+000 to Sta. 0+233.

(b) Concurrent Payment of Incentives - The incentive payment under 00198.10(a-1) is limited to a maximum of 14 Calendar Days ($490,000 total). Incentives may be assessed concurrently under the combination of Interim Completion Durations and Dates under 00198.10(a-1), (a-2), (a-3), and (a-4) above. The maximum incentive assessed under any circumstances for any given Calendar Day will not exceed $50,000 per day.

00198.30 Payment of Incentive - Each payment will be paid separately from all other Contract payments. Incentive payments for early completion will be paid only after completion and acceptance by the Agency.

I-5: N. SANTIAM – KUEBLER BLVD

(Insert the following subsections into the document in the appropriate locations. Be certain all other references to 00180.50 are deleted. [Do not make additional changes to the language, terms or sense as this would need further approval of DOJ][Be sure to delete all the "orange italicized" instructions])

00180.50 Contract Time to Complete Work – Replace subsections 00180.50(a) and 00180.50(d) with the following:

(a) General - Complete all Work to be done under the Contract within the "Contract Time" described in 00180.50(h).

(d) Recording Contract Time - All Contract Time will be recorded and charged to the nearest full day.

00180.50(g) End of Contract Time - In the bullet that begins "Submittals, including without...", replace "00170.70(e)" with "00170.70(b)".

Add the following subsections:

00180.50(h) Contract Time Dates and Durations - For purposes of 00180.50(h-2), 00180.86, and 00198, to be considered complete, the Work shall have been finished and completed to the satisfaction of the Engineer. The completion dates allowed are given in the following paragraphs (1), (2), (3), and (4):

(1) Complete all Work to be done under the Contract necessary to open Fairview Industrial Drive to a 2-lane, 2-way Roadway, not later than March 31, 2007
(2) Complete all Work to be done under the Contract, except placing HMAC wearing course paving, adjusting Inlets and manholes to final grade, constructing rumble strips, installation of median low profile, mountable curb work, all planting, Plant Establishment Work, and installation of all permanent and durable striping, not later than November 15, 2007. See Section 00198 for Incentive and 00180.86 for Disincentive.
(3) Complete all Work to be done under the Contract, except for Plant Establishment Work and Methyl Methacrylate Non-Profile, 3.0 mm, Extruded, not later than June 30, 2008.
(4) Complete all Work to be done under the Contract, except for Plant Establishment Work, not later than July 31, 2008.

Methyl Methacrylate Non-Profile, 3.0 mm, Extruded and Painted Permanent Pavement Striping

00180.65 Right-of-Way and Access Delays - Add the following paragraph:

It is anticipated that the ending dates for anticipated delays of entry for Right of Way hold outs will be as follows:

File No. 7096004 – November 30, 2005
File No. 7096005 – November 30, 2005
File No. 7096006 – November 30, 2005

(Insert the following subsections into the document in the appropriate locations)

00180.85(b) Liquidated Damages - Add the following paragraphs:

There are four daily amounts of liquidated damages on this Project as follows:

Liquidated damages for failure to complete the Work on time required by 00180.50(h-1) will be $1,600 per Calendar Day *. Liquidated damages for failure to complete the Work on time required by 00180.50(h-2) will be $2,000 per Calendar Day *. Liquidated damages for failure to complete the Work on time required by 00180.50(h-3) will be $2,000 per Calendar Day *. Liquidated damages for failure to complete the Work on time required by 00180.50(h-4) will be $2,000 per Calendar Day *. If liquidated damages should become payable concurrently under the combination of 00180.50(h-1), (h-2), (h-3) and (h-4), liquidated damages will be $2,000 per Calendar Day *.

Liquidated damages will not be assessed concurrently with a disincentive assessed according to 00180.86, instead, for any time that liquidated damages under 00180.85(b) and disincentive(s) under 00180.86 could be assessed concurrently, only the applicable disincentive(s) of 00180.86 will be assessed.

* Calendar Day amounts are applicable when the Contract time is expressed on the Calendar Day or fixed date basis.

(Insert the following subsections into the document in the appropriate locations)

Add the following subsections:

00180.86 Disincentive for Late Completion - The Agency will assess the Contractor disincentives as follows:

Interim Completion Date - For each Calendar Day that all Work, except placing HMAC wearing course paving, adjusting Inlets and manholes to final grade, constructing rumble strips, installation of median low profile, mountable curb work, all planting, Plant Establishment Work, and installation of all permanent and durable striping to be done under the Contract remains uncompleted after November 15, 2007, the Agency will assess a disincentive of $10,000 per Calendar Day, up to a maximum of 60 Calendar Days, to be deducted from the next regular payment due the Contractor.

(b) Concurrent Assessment of Disincentives - The maximum disincentive assessed under any circumstances will not exceed $600,000. Disincentives will not be assessed concurrently with liquidated damages. For any time the Contractor is out of compliance with 00180.50(h-2), only the disincentive of 00180.86 will be assessed, until the maximum disincentive has been reached (if applicable), or Agency otherwise ceases to assess the disincentive(s), at which time the applicable liquidated damages under 00180.85(b) will be assessed.

(c) Incentive for Early Completion See Section 00198.

(Insert this Section into the document immediately following Section 00197)

SECTION 00198 - INCENTIVES FOR EARLY COMPLETION

Section 00198, which is not a Standard Specification, is included in this Project by Special Provision.

00198.00 Scope - To encourage the Contractor to complete all except placing HMAC wearing course paving, adjusting Inlets and manholes to final grade, constructing rumble strips, installation of median low profile, mountable curb work, all planting, Plant Establishment Work, and installation of all permanent and durable striping Work to be done under the Contract, within a shorter time span, thereby reducing expenses to the Agency and economic losses to businesses and the public, the Agency will pay to the Contractor an incentive award for early completion.

00198.10 Incentive Award - The amount of the incentive award will be $10,000 per Calendar Day, up to a maximum of 60 Calendar Days, counted from the actual date of completion prior to November 15, 2007 (see 00180.50(h-2)). Any partial day will be rounded to the nearest whole day. The maximum incentive award to be paid under the Contract will not exceed $600,000.

00198.30 Payment of Incentive – Each payment will be paid separately from all other Contract payments. Incentive payments for early completion will be paid only after completion and acceptance by the Agency of the Work.

00220.40(f) Liquidated Damages - Lane closures not in compliance with the limits listed in 00220.40(e) would inconvenience the traveling public and would be a cost to the Agency.

It is impractical to determine the actual damages which the Agency would sustain in the event a traffic lane is closed. Therefore, the Contractor shall pay to the Agency, not as a penalty, but as liquidated damages, $5,000 per 15 minutes, or any portion thereof, per lane, for any lane closure not in compliance with the limits listed in 00220.40(e). In addition to the liquidated damages, any added cost for traffic control measures, including flagging, required to maintain the lane closures beyond the permitted time limits, shall be at the Contractor's expense. The required traffic control measures will be as determined by the Engineer.

The Engineer will determine when it is safe to reopen a lane to traffic. Assessment of liquidated damages will stop when the lane has been safely reopened. Any liquidated damages assessed under these provisions will be in addition to those under 00180.85(b).

APPENDIX C: DRAFT OPERATIONAL NOTICE

Highway Division
Project Delivery Leadership Team
Operational Notice

.NUMBER	REVISION #	SUPERSEDES	EFFECTIVE DATE	LAST REVIEW	RESCINDED DATE
PD-17	New	N/A	Spring 2007	N/A	N/A
SUBJECT Incentive/Disincentive Contracting Provisions			ISSUING BODY Project Delivery Leadership Team (PDLT)		

PURPOSE: To provide guidance and clarification on the use of Incentive/Disincentive (I/D) contracting provisions, excluding those pertaining to quality.

BACKGROUND: Incentive/Disincentive (I/D) contracting is an industry standard practice typically used to maintain construction completion dates, encourage innovation in work sequencing and accelerate project delivery. The decision to accelerate a project involves the consideration of many factors, such as:

- political pressures
- legal constraints
- legislative priorities
- community interests
- project goals
- context sensitivities
- any other factors impacting scope, schedule and budget
- funding availability
- staffing capacity
- mobility issues
- project complexity
- social and physical environment

Implementation of I/D includes several decision-making processes throughout the life of the project:

1) Identification of goals and needs for "date certain" completion scheduling
2) Identification of goals and needs for accelerating a project schedule
3) Evaluation of project suitability for I/D methods
4) Selection of the contract type
5) Determination of key parameters
6) Preparation of specifications
7) Procurement
8) Contract administration

See Figure 1 – I/D Decision & Implementation Process Flowchart

RATIONALE: There are several benefits to implementing I/D on projects:

1) **Reduce mobility impacts**: Shortened project durations can improve mobility during construction.
2) **Ensure context sensitivity:** Shortened project durations can lessen the impact on local businesses and communities by reducing the time that business and/or residential access is potentially disturbed or restricted.
3) **Improve public relations**: Shortened project durations can demonstrate consistent and continuing work observable to the traveling public.

4) **Reduce overall project costs**: I/D provisions can be less costly then lengthier project durations.
5) **Increase overall project delivery**: Shortened project durations may allow more projects to be completed in a construction cycle.

I/D DECISION PROCESSES:

Key Roles in the decision-making process:

Region Mobility Team	consider region/corridor mobility issues
Team Leader	consider context of project, community/stakeholder concerns/impacts, mobility issues; document decisions; use I/D Calculator Tool to determine I/D values
Project Team	consider options, context, mobility, environment and make recommendation
Area Manager	decision to use or not use I/D
Region PDLT	determine appropriate use of I/D
Technical Services	provide technical review of I/D amounts/specs (as part of PS & E submittal)

Project Initiation Milestone - While the decision to use I/D provisions may be introduced at later project stages, it is at the Project Initiation stage that the recommendation to use I/D will be most effective. I/D should be included when analyzing mobility considerations (see PD-16, Mobility Management).

<u>Identification of goals and needs for managing work for a “date certain” completion requirement</u> – The Region Project Delivery Leadership Team (RPDLT) identifies the element(s) of the project that could potentially benefit from maintaining construction delivery times. Generally, the implementation of I/D provision adds additional administrative overhead to a project; therefore, it is recommended that the following criteria be considered as a minimal threshold for choosing to implement I/D:

1) The I/D-focused portions of the project meet criteria identified in FHWA T5080.10
   a. Safety projects which are to correct extremely hazardous conditions where the traveling public may be in danger.
   b. Emergency repair or replacement of damaged facilities.
   c. Projects to close gaps in otherwise completed facilities to allow opening to traffic.
   d. Projects that are critical elements in a staged or phased construction schedule, where a delay would mean substantial impact on the completion date of the facility.

<u>Identification of goals and needs for accelerating a project schedule</u> – The Region Project Delivery Leadership Team (RPDLT) identifies the portion(s) of the project that could potentially benefit from acceleration. Generally, the implementation of I/D provision adds additional administrative overhead to a project; therefore, it is recommended that the following criteria be considered as a minimal threshold for choosing to implement I/D:

1) Project is over $5 million unless a specific cost/benefit analysis is developed that indicates I/D benefits to a smaller project.
2) The I/D-focused portions of the project are at least 3 months in duration.

Evaluation of project suitability for I/D methods – The Project Team sets the project context according to the factors listed in the "Background" section of this document and evaluates the project's suitability for I/D methods. See Figure 2 - I/D Project Suitability Checklist. The recommendation to implement I/D is considered and approved by the RPDLT.

Although the evaluation may indicate a benefit to I/D implementation, other factors inherent in the project, such as unresolved utility issues or lack of project administrative capacity, may be cause to reject I/D use.

Design Acceptance

The final decision regarding the use of I/D provisions is made during the Design Acceptance milestone and should be documented as part of the Design Acceptance Package. As the project development progresses through Advanced Plans, and the parameters and constraints of the project are further developed, the suitability of the project should be reviewed to ensure that the design, specifications, schedule, etc., are still compatible and appropriate for I/D.

Unusual conditions or restrictions for construction may result in "date certain" completion requirements and support the use of I/D's to ensure completion on specific dates for projects not previously identified for I/D provisions (i.e. night-time noise prohibitions; environmental restrictions impacting schedule). Stakeholders, local governments, law enforcement, emergency services, and traffic and construction engineers should be consulted in the I/D decision making process.

For larger daily I/D values, (over $10,000 per day) a review should be performed to ensure that the disincentive risk is not too high and the bid pool is maintained for I/D success. For projects over $20 million, a constructability review should be considered to ensure I/D success. The use of I/D should be considered for any project engaged in a Value Engineering review.

Advanced Plans

Once a decision has been made to accelerate the project using I/D provisions, key parameters for the contract must be determined. These include the determination of road user costs, I/D amount, I/D caps, maximum time allowed and minimum time allowed for the incentives portion. The Team Leader utilizes the I/D Calculator Tool to determine the appropriate I/D values. **All I/D specifications require a Department of Justice (DOJ) review** coordinated through Technical Services.

Specifications

The specifications must adequately draw the bidders' attention to the unique aspects of the I/D contracting method. Due to possible conflicts with any standard specifications, a careful reading of established specifications should be made to ensure that conflicts are eliminated. Consideration should be given to standard specification sections dealing with bid award, scheduling, contract time and adjustments, definitions, liquidated damages and others impacted by I/D. New specifications must be included that describe the incentive/disincentive program. The Traffic Control Designer and Specifications Writer collaborate to develop the final specifications, utilizing the I/D values provided by the Team Leader.

Incentive Amount and Duration:
A dollar amount per day for I/D provisions needs to be determined. To be effective and accomplish the objectives of I/D provisions, this amount must be of sufficient benefit to the contractor to encourage his/her interest, stimulate innovative ideas, and increase the profitability of meeting tight schedules. It must be enough to cover the contractor's cost of the accelerated work (additional crews, overtime, additional equipment, etc.).

The amount of the Incentive Award shall be established by using ODOT's I/D Calculator Tool. The total I/D amount should be evenly distributed by the total calendar days of the project, counted from the actual date of the completion prior to the established estimated completion date.

ODOT's predetermined road user cost value should be specified if it becomes the basis of the I/D. Costs attributed to the disruption of adjacent businesses should not be included in the daily I/D amount. Engineering judgment may be used to adjust the calculated daily amount downward (not upward) to a final daily I/D amount that:

1) Provides a favorable benefit/cost ratio to the traveling public. The benefit is the calculated daily savings in road user and ODOT costs; the cost is the daily I/D amount; and
2) Is large enough to motivate the contractor.

If a favorable benefit/cost ratio cannot be realized and/or the resulting daily amount is not high enough to motivate a contractor, the project should not be further considered for I/D.

Disincentive Amount and Duration:
The disincentive amount and duration should be established at the same daily amount and project maximum as the incentive. Disincentives cannot be assessed concurrently with liquidated damages. If the agency ceases to assess the disincentive(s), the applicable liquidated damages can be assessed.

Cap
All I/D provisions must contain a cap amount. The allocation for the potential award of the entire incentive amount should be factored into the Agency's construction budget.

Final Plans and PS & E Submittal
Technical Services will provide a final quality check review of the I/D amounts and specifications as part of the PS & E submittal process.

Documentation Requirements
While there are no current FHWA requirements for a formal submittal of I/D documentation FHWA does require that, documentation of the decision process, rationale and justification, and I/D values arrived at is maintained within the project files for audit purposes. Informal notification for its use on specific projects is also requested by FHWA.

Construction

When transitioning the project from development to construction, the rationale for and parameters of the I/D provision should be discussed, including any potential interferences or concerns held by the contractor.

During construction, success of the I/D project will require prompt decision-making, approvals, problem solving, and conflict resolution. Discussions between ODOT and the contractor should consider future critical operations and potential problems.

The contractor shall be required to submit and actively manage a Critical-Path Method (CPM) schedule. During the life of the contract, the contractor must meet all milestones and completion dates.

REFERENCES:

ODOT Research Project SPR 630: "Establishing Guidelines for Incentive/Disincentive (I/D) Contracting at ODOT"

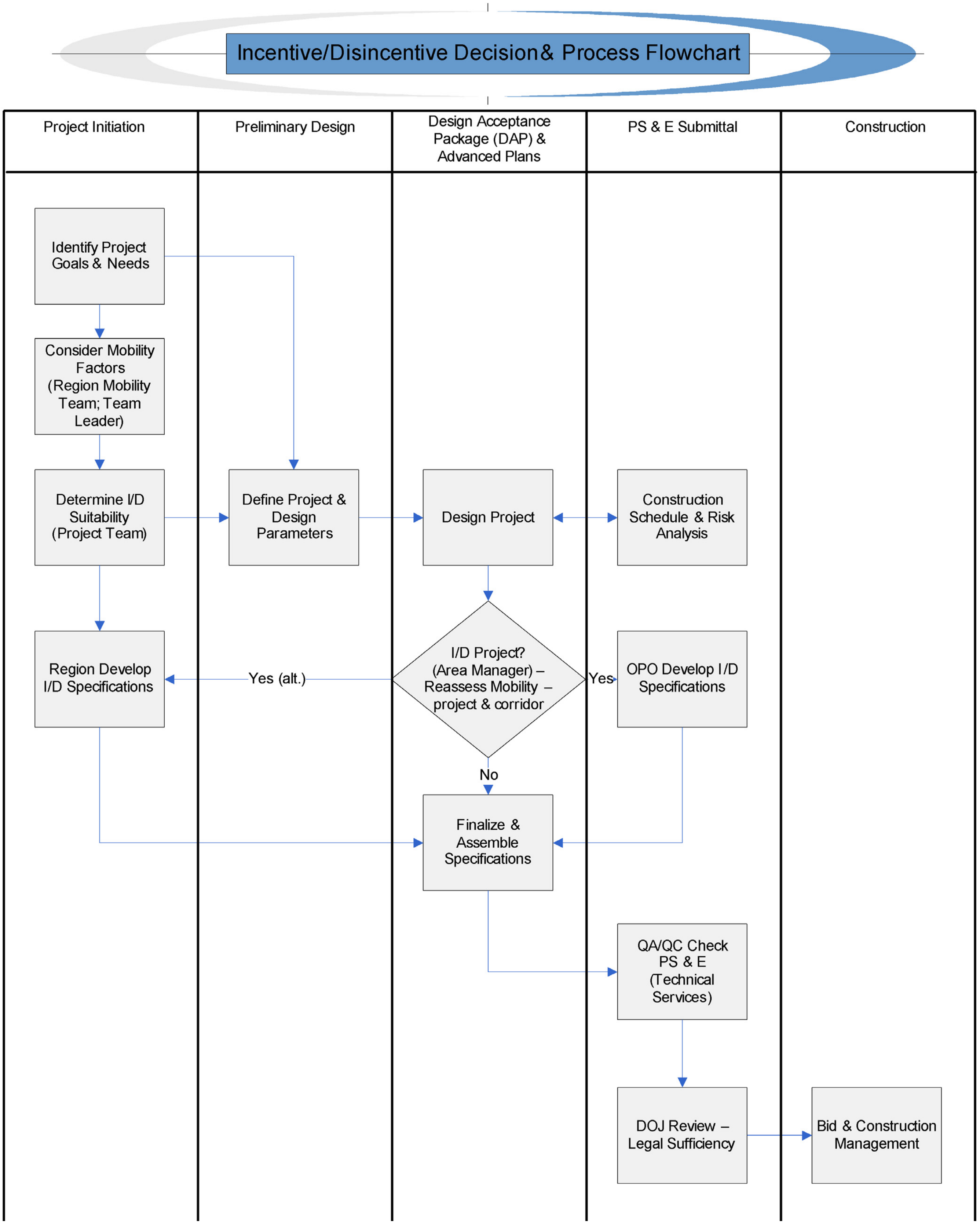
FHWA (1989). "Incentive/Disincentive (I/D) for Early Completion – T 5080.10". Technical Advisory, http://www.fhwa.dot.gove/legsregs/directives/techadvs/t508010.thm (August 2005)

I/D Calculator Tool – link to be added when tool available

I/D Calculator User Guide – link to be added when tool available

NOTE: When finalized, the current version of the PD-17 may be found at this online location of the ODOT Office of Project Delivery: http://www.oregon.gov/ODOT/HWY/OPD/PoliciesGuides.shtml#Operational_Notices

PD-17, Figure 1



PD-17, Figure 2

I/D Project Suitability Checklist

A significant number of "yes" responses indicate the project is highly suitable for acceleration.			
Suitability Factors	**Yes**	**No**	**Notes**
Public Convenience (Mobility); Mobility plan indicates:			
High traffic volumes at the project site.			
Project will involve high impact restrictions, closures, and/or detours.			
Project will cause severe traffic disruption due to reconstruction or rehabilitation on an existing facility.			
Lengthy detours for high traffic volumes will exist.			
The project will create significant impacts to the trucking industry.			
Multiple projects exist within the corridor.			
Constructability			
Contractors' expertise is needed to facilitate an earlier completion.			
I/D portion(s) can be completed in one construction season or less.			
Traffic control phasing can be structured to maximize a contractor's ability to reduce the duration of construction.			
The project is relatively free of utility conflicts, design uncertainties, or right-of-way issues which may impact the bid letting date or the critical path of the project schedule.			
Contractors with sufficient resources to complete the project are available.			
Public Safety			
Safety concerns will exist during construction, including impacts to pubic, pedestrian, and/or worker safety.			
A disruption of emergency services will occur.			
Emergency response to an unexpected loss of highway facility will be hindered.			
Public Priority (Stakeholder Participation); Stakeholder Participation plan indicates:			
It is in the public interest to complete the project as soon as possible, or by a specific completion date.			
Adjacent neighborhoods or businesses will suffer significant impacts.			
Major bridges will be out of service.			
The project will interfere with major public events.			
The project is highly sensitive to the community.			
Other Factors			
Time-sensitive environmental issues/impacts exist.			
ODOT has resources to commit to ensuring prompt decisions, approvals, problem-solving and conflict resolution during construction.			

APPENDIX D: GLOSSARY

GLOSSARY

A+B + I/D Cost plus time bidding method accompanied by the application of incentive/disincentive provisions.

A+B Cost plus time bidding method.

Best Value A contracting practice when the bid value is based on a combination of the cost component and a calculation of the cost of time.

Cost of acceleration The additional cost a contractor incurs due to expediting the delivery of a contract. It includes direct and indirect costs, profit, and additional markup (risk, administration costs).

Incentive/Disincentive (I/D) A monetary component included in some construction contracts to encourage completion of the project or a segment of the project by a specified date.

Liquidated damages A monetary component of some contracts used to enforce completion times and quality standards, applied deductively on projects that complete late.

Lower boundary The minimum amount for an incentive/disincentive component of a contract. It is equal to the contractor's cost of acceleration.

Road User Cost (RUC) The estimated cost to the traveling public resulting from travel delays due to construction work being done or other incidents that impede traffic.

Upper boundary The maximum amount of an incentive/disincentive component of a contract, equal to the cost of delay to the public. This value is normally established through the calculation of Road User Costs (RUCs).