

WHITE PAPER: WHY TARGET VALUE DESIGN AND INTEGRATED PROJECT DELIVERY? A TALE OF TWO CITIES

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INTRODUCTION

Two sister cities, Rosencrantz and Guildenstern, have both decided to each build a new library for their citizens. Both cities have roughly the same budget (100 million coins) and a schedule of 3 years. They want to complete the project before their centennial celebration. As rival cities they are in competition with each other to get the most value out of their projects. As public entities, they received a fixed amount of money from their citizens and are held accountable to deliver the project within schedule, budget, and quality. There is no difference in the capabilities of the architects, contractors, consulting engineers, and builders available to the two cities. The only difference is in their project delivery system. As the story unfolds, although the two cities have the same requirements for their projects, the difference in their project delivery system results in different outcomes.

ROSENCRANTZ

After obtaining a budget and land grant for the library, the project manager of Rosencrantz set forth to hire an architect. The architect was selected solely based on their qualifications and was paid an hourly rate to develop the drawings for the new library. The owner communicated with the architect about the scope of the project (a two-story library which can house 10,000 tomes, 2 public reading rooms, and at least 5 private reading rooms), their financial constraints of 100 million coins, and their schedule constraint of 3 years. After 9 months of design, the architect completes a finished set of documents with an internal cost estimate of around 98 million coins with all the scope requirements that the owner had asked for. The city authorities then displayed the set of drawings in the town hall and invited all qualified contractors to submit a proposal. Four contractors (A, B, C, D) each submitted bids for 115 million, 130 million, 132 million, and 140 million coins respectively. Since the owner believed that all the contractors should be equally qualified, they awarded the contract to the lowest bidder (Contractor A).

Unfortunately, the estimate of even the lowest contractor (115 million coins) was still higher than the project's budget. The project manager from Rosencrantz then asked the architect to "redesign" the project to "eliminate" unnecessary scope so that the project can be within budget. The architect is furious because by making changes to the project, they would lose some of their design intent. In the end, some value-added scope (i.e., 2 private reading rooms) had to be eliminated from the design. Due to the

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tight constraint of time, the architect did not have time to readjust the design of the corridors to match the reduction of the private reading rooms. As a result, there is extra space in the corridors, which does not serve any meaningful function.

For the last couple of years, Contractor A's company has been in financial trouble. The recent recession caused by the famine had decreased the demand for new construction projects and almost every contractor in town is on the brink of bankruptcy. Contractor A decided to bid the Rosencrantz library project for 0 profit and planned to eventually make money through change orders. While reviewing the drawings, the contractor noticed that the architect forgot to include shelving for the tomes on the second floor. It was strange that such an important component of the project was missing but nevertheless the contractor was instructed to bid on what was documented in the drawings. They also laughed at the architect's detail for the exterior stones. The architect had specified one monolithic piece of stone for the side of the library. Based on the contractor's experience, it is not possible to cut such a large piece from the quarry nor was it possible to transport it to the construction site. Contractor A also saw an opportunity to use Corinthian marble instead of the more expensive Florentine marble specified by the architect. If they can get these changes approved, they should be able to make a profit on the project.

During the construction phase, Contractor A had several questions about the design. The design documents from the architect could be interpreted in a number of different ways. In order to clear up the confusion, the contractor sent a pigeon with a letter requesting for information. About 2 weeks later, the pigeon returned with a reply from the architect. Hundreds of pigeons were passed throughout the project, each returning 1 to 2 weeks later. Sometimes pigeons were unnecessarily sent back and forth to document information to protect the parties in case of a trial. While the contractor was waiting for the information, he could not proceed further. At the same time, the large number of pigeons sent in from the contractor took the architect a very long time to process. This problem was exacerbated by the fact that the architect was now focused on designing a new project (a coliseum) for a new client.

About 6 months before the centennial celebration, the project manager from Rosencrantz noticed that at the current rate of construction, the project would not be completed in time. They sent a notice to the contractor urging them to speed up the project so that they can have the library ready for the celebration. The contractor complied with the owner's request and hired more labours to finish up the project. Luckily, they were able to place the last stone a couple of days before the event and the library was unveiled during the city's centennial celebration.

After the celebration, the project manager from Rosencrantz re-examined the project. The final cost of the project was 125 million coins, which is 25 million more than their original budget. Some of the additional costs were due to missing details in the construction documents and others were due to claims made by the contractor (i.e., owner directed change and acceleration of the schedule). The owner was unhappy with the project because their original scope (i.e., 5 private reading rooms) was not met and the project ended up costing more than they had budgeted for. The architect

was not happy because their original design intent was compromised to meet cost. The contractor was not happy because after a long negotiation process only 30% of their change orders were compensated by the owner.

GULDENSTERN

Before starting on the new project, the project manager from Guildenstern critically examined the city's past projects. He found that overall projects have been delivered over budget, behind schedule, and with questionable quality. In fact very few projects were completed without some compromise to cost, schedule, or scope. The last bridge project cost 200% more than the initial estimates and took 3 years longer than expected. The community hospital project ended up costing 150% of the initial estimates and some of the functional components had to be removed to avoid further cost overruns. The aqueduct project resulted in a 5-year battle at the highest court in the land and was a drain on his team's resources and energy.

Some anomalies that he observed include:

- (1) The initial budget agreed between him and the architect was almost always exceeded.
- (2) The architect's estimate was always less than the contractor's estimates and so the real price was only revealed after the design had already been completed.
- (3) A "redesign" process was always needed to conform the design to the budget.
- (4) There was always missing scope in the design documents that he had to pay for later.
- (5) As much as 15% of the architect's and contractor's time were spent documenting and protecting themselves from an impending lawsuit rather than working on the project.
- (6) Selecting the lowest bidder did not always result in the lowest price.
- (7) Project participants had temptations for local optimization rather than optimizing for the whole project.
- (8) The value that he had intended to achieve was rarely met without having to spend more money.
- (9) There was no incentive from either the architect or the contractor to reduce cost other than to make the project feasible.
- (10) If he asked whether or not a project was successful, the answer would vary from party to party and is not necessarily correlated with his definition of project success.
- (11) A high number of projects ended up going to court. It seems like everyone was prepared for the worst-case scenario and always conducted the project in anticipation of a legal battle in the high courts.

The project manager from Guildenstern realized that if they use the same method as they have in the past, they would get the same results. Although the results are predictable, they are predictably bad. Given these systemic and reoccurring problems, there must be a better way.

For him, a better project delivery system would:

- (1) Have a higher likelihood that the project would be completed on budget, within schedule, and deliver its intended value.

- (2) Bring the builders into the design process where their expertise can be leveraged early-on.
- (3) Align the financial incentives of the architect, builders, and owner to delivery the best quality project.
- (4) Incentivize the architect and the contractor to innovate and find cost savings alternatives which would deliver the owners value for a lower cost.
- (5) Allow project participants to focus their attention on innovating and creating rather than fighting.
- (6) Allow project participants to work as a team rather than as adversaries.
- (7) Allow the architects and builders to earn a fair profit if the project is delivered successful.
- (8) Allow profits to be earned by the designers and builders rather than the lawyers.

He started the project with a design contest between 3 teams each consisting of an architect and a contractor. Each team proposed a conceptual design that met the project's scope, budget, and schedule requirements. The winning team was selected based on their qualifications, the quality of their design, and their fees. The craftsmen and the engineers who generally work under the general contractor and the architects respectively were brought onto the project as partners. The scope and values of the owner was validated with a cross-functional team rather than just with the estimates from the architect. Designers and builders were co-located near the construction site to encourage better communication flow. All of their profits were be place in a risk pool and the team shared in the gains and pains of the project.

From the 100 million coins budget, the team's estimated cost of work was 85 million coins. 5 million coins were allocated as the contingency and 10 million coins were allocated for the team's profit. If the team could delivery the project with a cost of work less than 85 million, the shared savings would be divided between the participants and the owner. If the project ended up costing between 85 million and 100 million coins, the contingency and the profit is depleted to cover the cost overrun. The team would share in the remaining profits and the owner would still be able to meet their budget of 100 million coins. If the project costs more the 100 million coins, the owner would pay the team for their cost of work and no profits.

By changing the project delivery system, the project manager from Guildenstern noticed that there was a greater atmosphere of trust, collaboration, coordination, and communication between the team members. During the design stage, the craftsmen helped the architect choose a design that met the aesthetic requirements and was cost-effective to build. In many cases there were heated discussions, but the discussions were in the right areas. The discussions were not about blaming each when problems occurred but rather to devise solutions to overcome problems and to help the owner achieve the best value within the constraints of the project. Through the coordination meetings, the architect was able to develop much better plans by taking in input and knowledge from the craftsmen. Likewise, the construction phase was much smoother due to better thought out plans that required less guesswork for the builders.

Under the new project delivery system, the Guildenstern library was completed on budget, on schedule, and within the required scope. Due to the team's increased efficiency, they were able to include 2 additional private reading rooms into the project at not additional cost the owner (7 private reading rooms in total).

One member from the contractor remarked that: "In the past for me to get information from the consulting engineer who works under the architect, I had to send a pigeon to the architect. The architect then sent a pigeon to the consultant. I could never communicate directly with the consultant, which was frustrating. Every time we have an intermediate pigeon, the message can be distorted, miscommunicated, or lost. Being able to talk directly with the consultant on this project has made my job a lot easier."

The success of the Guildenstern project did not come without hard work. Change is hard. It is especially difficult when the project participants have been used to working in an adversarial environment for so long. Our tools and processes can be easily changed, but our mental model of the world and our personalities take much longer to change. Several of the members on the Guildenstern project could not grasp the new collaborative environment and had to be replaced. The project manager from Guildenstern spent a considerable amount of time educating everyone about the new process. The transition from a top down hierarchical governance where the architect and the contractor had all the power to a shared governance model was difficult for those who had traditionally held the power. The share governance also brought about new problems with regards to the division of work and responsibility. Within the team, trust was very difficult to build at first because many of the team members had, in the past, stood on opposite sides in the court of law.

The Guildenstern's project delivery system is based on trust and not everyone is right for it. The team had to carefully select only qualified and trusted partners. A bad partner can be detrimental to the team's morale and profitability. Training and on-going education were essential to get everyone on the same page and to understand how this project delivery system is different from the Rosencrantz's system. Partners need to be capable of developing highly accurate cost estimates and revise them frequently throughout the project. This project delivery system requires partners who are willing to collaborate and trust each other. And most importantly, it requires an enlightened owner who truly believes in the process and is able to take a hands-on role in the project.

DISCUSSION

The tale of two cities highlights some systemic problems within the AEC industry. The Rosencrantz story shows some of the problems with the Design-Bid-Build project delivery system. The Guildenstern story introduces how Target Value Design and Integrated Project Delivery (TVD/IPD) can overcome some of these problems through an alignment of commercial incentives, trust, collaboration, coordination, and shared governance. The Guildenstern story also shows some of the challenges with regards to changes in roles and attitude that is required when transitioning to TVD/IPD. As a reader, you are probably wondering: are the benefits real or are they merely just folklore? Fortunately, numerous scientific studies have been reported on

TVD/IPD and the evidence shows that TVD/IPD is superior to DBB in terms of schedule, cost, quality, and cost overrun control (Ballard and Rybkowski 2009; Do et al. 2014; Matthews and Howell 2005; Seed 2014; Ziminia et al. 2012). The first generation of TVD/IPD projects has been delivered 15% to 20% below market price and without any compromises to schedule or quality (Ballard and Rybkowski 2009; Ziminia et al. 2012; Seed 2014). Do et al. (2014) reported that TVD projects are less likely to experience cost overrun than projects that do not use TVD.

For more information on Target Value Design, refer to Ballard and Reiser (2004) and Ballard (2011). For more information on Integrated Project Delivery, refer to Campbell (2001), Cohen (2010), Lichtig (2005), Matthews and Howell (2005), and Thomsen et al. (2009).

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