

1     **Project control through disincentivisation: A case study**  
2             **of Hong Kong-Zhuhai-Macau Bridge Project**

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8             **Abstract.**

9             Incentives and disincentives (I/D hereafter) arrangements have been regularly  
10            used as project control measures. Incentives aim to enhance performance through  
11            reward provisions whereas disincentives penalise performance below agreed  
12            targets. Use of Incentives are based on motivation theories and has been well  
13            recognised as catalyst for performance. Disincentives are relatively less studied  
14            even though it is also commonly used to deter underperformance. Compared with  
15            incentives, disincentives are less costly and can function well when monetary  
16            reward is not the sole performance motivator. This proposition is discussed and  
17            illustrated through a case study on the Hong Kong Zhuhai Macau Bridge  
18            (HZMB) project. In the HZMB project, disincentivisation was integrated with  
19            the Reputation Evaluation System (the System hereafter). The System has four  
20            parts: 1) Goal Commitment; 2) Reward/Responsibility reallocation; 3)  
21            Monitoring method application and 4) Performance Assessment. Through focus  
22            group discussions, it is found that 1) The System is a useful project control tool;  
23            2) The desire to maintain reputation underpins the effectiveness of The System;  
24            and 3) The System is instrumental in relationship building. Disincentivisation is  
25            effective in the HZMB when it is linked with the performance status of the  
26            contracting organisations. The importance of maintaining reputation in signature  
27            projects like the HZMB makes disincentivisation a less costly and viable project  
28            control measure.

29            **Keywords:** Hong Kong-Zhuhai-Macao Bridge; Disincentives; Project Control,  
30            Project Performance.

31     **1 Introduction**

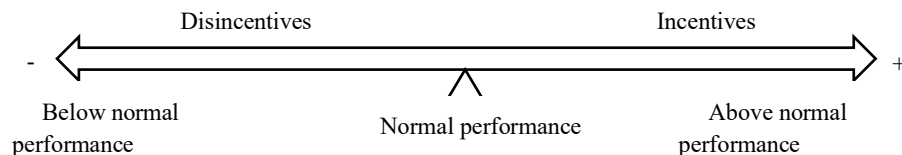
32     Mega projects are usually 1) large-scale; 2) complex; 3) high value; 4) long-period;  
33     and 5) having significant social impacts [1]. The success or failure of a mega project  
34     affects the development of a region or even a country. For project management, how to  
35     handle multi-tasks and coordinate engaged parties to work together are key challenges.  
36     Based on transaction cost economics theory, opportunism is a major threat when  
37     project uncertainty is high [2]. Incentive and disincentive (I/D hereafter) arrangements

38 have been regularly used as project control measures to alleviate opportunism.  
 39 Furthermore, incentives aims to enhance performance through rewards whereas  
 40 disincentives penalise performance below agreed targets. Use of Incentives is based on  
 41 motivation theories and has been well recognised as catalyst for performance [3], [4].  
 42 Through years of research, many studies analysed the effects of positive incentive  
 43 mechanisms and found it can enhance project performance, reduce dispute and nurture  
 44 innovation [5]. The working of disincentives is relatively less studied even though it is  
 45 also commonly used to curb non-performance. Valid cases and general guidelines are  
 46 needed to substantiate how it is operated and what purposes it can also achieve. The  
 47 study aims at investigating the value of disincentivisation for project performance  
 48 planning. efficient selective incentive planning. The research objectives are organized  
 49 as follows:

- 50 1) Identify the project control functions of disincentives; and
- 51 2) The project prerequisites for the use of disincentives.

## 52 2 Literature Review

53 Incentives and/or disincentives have been used as the standard project management tool  
 54 to engender project performance [6]. It is believed that motivation can be derived from  
 55 incentivisation, disincentivisation or combination of both [7]. These arrangements are  
 56 typically described as ‘risk–reward’ or ‘gain share–pain share’ arrangements [4].  
 57 ‘Carrot or stick’ is used to describe client using incentive and/or disincentive (I/D  
 58 hereafter) arrangements to reward or penalize the contractor for above or under  
 59 performance respectively [7]. Project performance is often identified by cost, schedule  
 60 and quality. Schedule-incentive planning is seen as the most common type of a  
 61 combination of I&D [8]. Client set financial bonus as reward for early completion and  
 62 liquidated damages for delay. From the perspective of project performance, I&D are  
 63 both possible contractual tools to serve project control purposes [9]. The primary  
 64 purpose of applying I/D is to established agreed targets that are acceptable to both client  
 65 and contractor. With that, both contracting parties do their utmost to enhance project  
 66 performance [7]. Accordingly, incentives are used to motivate the contractor for above  
 67 normal performance and disincentives are used to discourage below normal  
 68 performance. Figure 1 shows the spectrum of I/D:



69

70

**Fig. 1.** Incentives and Disincentives on a spectrum (Adapted from [6])

71 Incentives and disincentives can be used either separately or together. The  
 72 integration for project objectives and incentive planning is one of the key issues for

73 efficient project management. For example, [10] analysed the case of National Museum  
 74 of Australia Project. As the client only aimed to ensure on-time completion, pure  
 75 disincentives is sufficient for pushing timely completion. Based on the nature and  
 76 complexity of the project. the selection of I/D also reflects the different expectations  
 77 for project results. For cost management, the intention to shift cost-overrun risks by  
 78 setting cost-ceiling or to reward contractor for cost-saving reflects two different  
 79 expectations for the project.

80 [11] analysed the dynamics of disincentives through comparing these two  
 81 strategies. It was found disincentives take effect for motivating unanimous cooperation  
 82 while incentives are effective more 'elite' actions. Disincentivasation also have its  
 83 value when dealing with multiple agents [12]. It is costless compared with positive  
 84 financial bonus. In an ideal situation, if everyone cooperates, the only cost of  
 85 disincentives is that of threatening to use it [11]. [13] further analysed the role of  
 86 disincentivasation in project monitoring. In that case. disincentives in terms of time,  
 87 cost, safety and quality were integrated into performance control system.  
 88 Disincentivasation strengthens client's controlling power and ensures the dominance  
 89 position in the middle stage of the project. The effectiveness was also confirmed as it  
 90 played a driving role in encouraging best practice and ensuring project success. To  
 91 present a clear view of the functions of disincentivasation, the comparison of I&D is  
 92 summarized in Table 1:

93 **Table 1.** Comparisons of Incentives and Disincentives in construction project

No.	Content	Incentives	Disincentives	Ref
1	Objective	Motivate better performance apart from the contract	Demotivate underperformance to safeguard the contract	[6]
2	Manifestation	Financial Bonus	The penalty of fine	[14]
3	Advantage	Attractive	Costless	[11]
4	Expectation	Additional value apart from the contract	Contractual safeguards	[10]
5	Essence	Encourage contractor to finish their expectations	Force contractor to comply with their requirements	[6]
6	Function	Motivate small numbers of co-operators and generate pressures toward smaller, more "elite" actions	Motivate unanimous cooperation for multi-agents	[11]
7	Sphere of application	Objective and interest alignment	Project monitoring	[13]

### 94 **3 Case Study: The Hong Kong Zhuhai Macao Bridge Project**

#### 95 **3.1 Project background information**

96 To promote economic exchanges and cooperation among Hong Kong, Guangdong  
97 Province, and Macao, a mega cross sea transportation channel was started in 2007 and  
98 envisaged. The Hong Kong-Zhuhai-Macao Bridge (HZMB hereafter) project is  
99 considered as one of the largest highway projects in China. HZMB is also one of the 10  
100 major infrastructure projects of Hong Kong [15]–[17]. The total length of the crossing  
101 is around 55 km, which includes a 29.6 km main bridge, a 6.7km undersea tunnel, two  
102 artificial islands and ports in three cities. After 8 years’ construction, the HZMB was  
103 opened for use in October, 2018. Notable accomplishments were reported in terms of  
104 time, cost and innovations. Along with achieving all the project targets, over 400  
105 patents were harvested[18]. All the technical accomplishments together with the  
106 management experiences have greatly promoted the development for construction  
107 supply chain development in high-tech material manufacturing, reclamation and  
108 underwater tunnel construction in China [18]. This project is also considered as a key  
109 demonstration project. All the accomplishments of new technologies, project  
110 experiences and innovations such as rapid island formation will be passed on too many  
111 similar planning cross-sea tunnel projects such as Shen-Zhen and Zhongshan Oversea  
112 Tunnel Project.

#### 113 **3.2 The use of disincentivisation in HZMB project**

114 The Hong Kong Zhuhai Macao Bridge Authority (HZMBA hereafter) was established  
115 by the Three Governments in 2010. It directly takes the responsibility of construction,  
116 operation and maintenance of the project. HZMBA proposed the following project  
117 pledges at the beginning of the project:

- 118 1) Build a world-class cross sea channel;
- 119 2) Provide high quality services for users; and
- 120 3) Become a landmark bridge in China.

121 Along with these project objectives, it is also noted that to accomplish this project,  
122 there are also complicated challenges need to be overcome [18] :

- 123 1) Construction challenges: no unified construction standards and previous  
124 experiences for this type of project;
- 125 2) Technical challenges: Multiple risks need to be managed for the construction of  
126 undersea tunnel, over-sea bridge, artificial islands.
- 127 3) Environment protection: Apart from the common environmental protection issues,  
128 it is needed to attach great importance to the impact on marine ecology and white  
129 dolphin protection.
- 130 4) Difficulty in coordination: Apart from the negotiation under different legal system,  
131 it is also difficult in coordinating multiple project participants in this mega project.

132 In this way, an effective contractual tool is needed to align HZMBA’s project  
133 expectations and deal with the challenges with all project participants. In this project,

134 HZMBA transfer all these requirements into the contractual language and developed  
135 the Reputation Evaluation System (the System hereafter). The System has four parts:

### 136 3.2.1 Goal commitment

137 This System for project management contains 6 goals:

- 138 a. Quality management: Ensure this project has a 120 year's life span, and meet all
- 139 the qualify required standards.
- 140 b. HSE: Health, safety and environment management.
- 141 c. Procedure management: The project needs to be completed on time.
- 142 d. Cost: Cost control within investment budget.
- 143 e. Information management: Maintain the openness of the system and to adopt
- 144 industrial standards to promote the interoperability of data exchangeability.
- 145 f. Innovation: Cultivate a series of excellent scientific and technological
- 146 innovations on technology and management.

### 147 3.2.2 Disincentives/Responsibility reallocation

148 Around 2% of contract value was set aside as special fund for operating this system.  
149 The contractual requirements were set based on previous project experiences collected  
150 from different departments of HZMBA. Because of the specialty of the project, some  
151 clauses such as white dolphin protection are added.

### 152 3.2.3 Monitoring method

153 A comprehensive evaluation is carried out quarterly by the HZMBA. An evaluation  
154 committee was established with members coming from different department. There was  
155 a quarterly assessment (every 3 months) for the project performance. A meeting was  
156 held for all the project participants

### 157 3.2.4 Performance Assessment

158 The evaluation committee conducted independent evaluation on contractors  
159 according to the implementation rules and grading standards. The total score is 100 and  
160 the score distribution is concluded in Table 2:

161 **Table 2** The score ratio of different targets

Item	Quality	HSE	Procedure	Cost	Information	Innovation
Score %	35	35	15	5	5	5

162 The evaluation is by way of mark deduction according to a pre-set scales included  
163 in the contract. When the project inspectors observe misbehaviours, they would deduct  
164 points according to the requirements in the contract. When the contractor makes major

165 errors or major deviations stipulated in the contract, the assessment shall be 0 points,  
 166 and the punishment shall be given in accordance with the relevant provisions. The  
 167 performance is directly linked to the payment ratio. Table 3 shows the relationship  
 168 between the evaluation level and bonus payment ratio.

169 **Table 3** The evaluation level and corresponding payment ratio of the fund

Comprehensive evaluation score: L	Evaluation Level	Bonus payment ratio
$L \geq 90$	AA	100%
$85 \leq L < 90$	A	90%
$80 \leq L < 85$	B	70%
$75 \leq L < 80$	C	50%
$L < 75$ or The qualification is cancelled	D	0

170 A contractor who receives two consistent “D” grade will be counted a breach of  
 171 contract. In such situation, the client can terminate the contract.

### 172 3.3 The Project Control Functions of the System

173 Focus group discussions were conducted to understand the functions of the System. In  
 174 this discussion, ten senior managers from HZMBA, main contractor, sub-contractor and  
 175 supplier who are familiar with the System participated in two rounds of discussion. It  
 176 is found that 1) The System is a useful project control tool; 2) The desire to maintain  
 177 reputation underpins the effectiveness of the System; and 3) The System is instrumental  
 178 in relationship building:

- 179 **1) The System is a useful project control tool.** The setting of the System basically  
 180 involves all major project key targets. Because of that, the scores provide an overall  
 181 view of contractors’ project performance. Through the System, all the  
 182 misbehaviours have been clearly shown through quarterly reports. It also provides  
 183 a clear vision for project controlling and next-stage project planning.
- 184 **2) The desire to maintain reputation underpins the effectiveness of the System.**  
 185 Through discussion, it was found that motivation for better performance is not  
 186 hinged on the threaten of losing money, but mainly on how to maintain their  
 187 reputations in this highly concerned project. The significance of a decent record  
 188 and the threaten of ‘losing face’ underpin the efficiency of The System in the  
 189 HZMB project. As the score rankings for all the project participants were  
 190 announced in each quarter. It also promotes a benign competitive environment for  
 191 all project participants.
- 192 **3) The System is instrumental in building relationship.** All the interviewees  
 193 confirmed that the System has more value for inter-organizational communication.  
 194 In the beginning of the project, due to different organizational management style  
 195 conflicts, deductions help demonstrate the intentions from HZMBA and attract the  
 196 contractor to come to the negotiation table. After several rounds of assessments, as  
 197 both parties are more familiar with each other, there is a significant decreasing of

198 deductions in these area. The interviewees agreed that this system is effective for  
 199 project management, especially for inter-organizational communication. The  
 200 communication and the sense of involvement are enhanced when negotiating the  
 201 scores for each quarter.

#### 202 **4 The project prerequisites for the use of disincentives**

203 The importance of maintaining reputation under a signature project like the HZMB  
 204 makes disincentivisation a less costly yet viable option to maintain project performance  
 205 even for projects are having high risks and facing immense uncertainties. The  
 206 followings are necessary actors for the use of disincentivisation:

##### 207 **1) Projects can instigate stringent supervision.**

208 From literature review, it can be seen that disincentivisation works well when  
 209 stringent project monitoring is exercised. In HZMB, the System contains all major  
 210 project objectives and provides detailed quarterly performance report. The scores  
 211 are indicators of underperformance should these are below the acceptable norms.  
 212 Contracting organizations received these feedbacks from HZMBA and were  
 213 expected to take necessary action to avoid penalties.

##### 214 **2) Monetary reward is not the singular performance motivator.**

215 Offering monetary rewards is often used when project conditions are not well  
 216 defined, risks and uncertainty are high. Incentives are used to provide buffer for  
 217 these contingencies. Moreover, for signature projects like the HZMB, maintaining  
 218 reputation may well be of the highest priority for the participating contracting  
 219 organisations. In HZMB, the System served as a performance ranking exercise.  
 220 The contracting organisations were very concerned about their positions on the  
 221 performance rankings. Keeping face was of vital importance for them.  
 222 Disincentivisation took effect when performance improvement acts were taken by  
 223 contracting organisations to save face.

#### 224 **5 Conclusions**

225 I/D arrangements have been regularly used as project control measures. Incentives are  
 226 performance motivators due to the embedded monetary rewards. Disincentives on the  
 227 other hand push performance when contracting organisations seek to avoid penalties  
 228 attached with underperformance. Disincentives are usually used for projects achieving  
 229 well defined scope and programmable tasks. Disincentives thus usually do not involve  
 230 Extra monetary rewards. The HZMB project was a high risk and complex project and  
 231 prima facie not suitable for use of disincentives. This study found that the HZMB project  
 232 used a Reputation Evaluation System (the System) to incorporate disincentive  
 233 arrangements. The System worked well to control the performance of the contracting  
 234 organisations not because of the penalties attached. It is the positions of performance  
 235 rankings that drove performance. The HZMB is a signature project and the participating  
 236 units all found pride in taking part in such project. Performance rankings were taken as

237 records of achievement and contributions in the making of a record-breaking project.  
 238 The desire to be part of the record making team turned out to be the most influential  
 239 performance motivator.

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