Study on the Relationship between Service Quality and Governmental Subsidy for Public School where PPP is Applied

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ABSTRACT

When PPP (Public Private Partnership) mechanism is gradually accepted by domestic academic and bureaus of different levels, PPP is not only used in municipal infrastructures. To get closer with international trend, PPP is also applied at Public Schools. Due to the nature of common weal, Public Schools cannot refinance through service charge from delivering education activity. Therefore, governmental subsidy is necessary throughout the life circle of PPP public schools. Many factors have impact to the governmental subsidies, and service quality is the key among them. Focus on service defects and stakeholders' satisfaction, by means of theoretical and mathematic models, this paper will study the relationship between governmental subsidies and service quality.

Keywords: public school, PPP, governmental subsidy, defects of service quality, satisfaction, education

INTRODUCTION

PPP (Public Private Partnership) is well known as a financing model and also a practical method to delivery public facilities through private sector's participation. Among all PPP projects, infrastructures like highway, power station, water treatment plants are often touched, while public buildings, like schools are rarely to find, except in certain developed countries. The main purpose of this paper is to facilitate the usage of PPP at public schools. Due to the nature of common weal, Public Schools cannot refinance through service charge from delivering education activity (Cruz, 2012). Therefore, governmental subsidy is necessary throughout the life circle of PPP public schools (Hare, 2013), (Chattopadhay, 2014). Many factors have impact to the governmental subsidies, and service quality is the key among them. This paper will analyze the relationship between governmental subsidy and service quality, through two methodologies. The first one, by means of quantifying the service quality's defects to analyze the deduction mechanism of governmental subsidy. The second methodology, based upon the satisfaction model of multiple stakeholders, to analyze the relationship between governmental subsidy and service quality. At last, the paper will give a summary and conclusion of these two methodologies.

THE RESEARCH MODEL OF QUANTIFYING DEFECTS OF SERVICE QUALITY

Public School is a place to deliver education, and the delivery of education activity is a kind of service. Any service must have its own quality, which can be verified by various methods. The main points of this part is to study the quality standard which SPC/SPV defines, to verify the difference between real service quality and quality standard, to quantify quality defects, to deduct governmental subsidy based upon quantified quality defects. The model structure is like below **Figure 1.**

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State of the literature

- Except in certain developed countries, PPP is not yet applied for Public Buildings, like Schools. The difficulty is the commonweal character of public school, in which private sector is not easy to refinance. (Cruz, 2012).
- Governmental Subsidy is a key to solve the PPP used at public schools, but how to quantify the subsidy is a big challenge. Currently, many paper may have touched this topic, but no detail mathematic model presented. (Hare, 2013), (Chattopadhay, 2014)
- The method of stakeholders' satisfaction is often used in sociology research, to judge the service level of public facilities, but not further related to the calculation of governmental subsidy in PPP model. (Aarseth, 2016), (Torvinen, 2016)

Contribution of this paper to the literature

- Research the relationship between service quality and governmental subsidy, to promote the frame of PPP model in public school and its application.
- The Methodology of quantifying defects of service quality, to balance governmental subsidy.
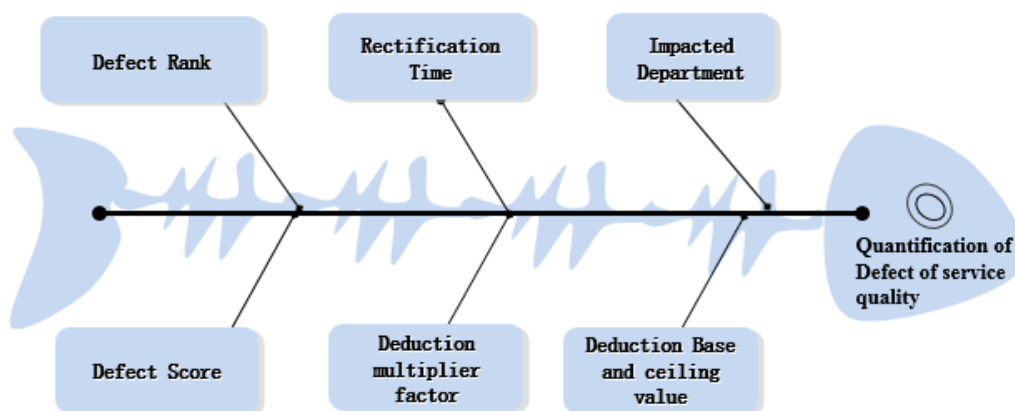- The Methodology of stakeholders' satisfaction, to balance governmental subsidy.

Figure 1. Quantifying model of service quality's defects

RANK OF SERVICE QUALITY'S DEFECT

Easy to understand, during the execution of any contract, defects from service quality will impact adversely the operation, which may cause loss of company. As the management of the company or the supervision administration, when it happens, the first thinking is to reduce or deduct interim payment to the service vendor, i.e. to deduct governmental subsidy (Verger, 2016). This deduction is used to authorize a third party to correct the defects, or to compensate the loss caused to the final users, or even used as penalty.

To verify the defects of service quality, and further to verify the rank of service quality's defect, a complete session of quality system and service standard is required (Amjad, 2014).

To facilitate execution, when signing concession contract of a public school, defects of service quality can be defined in the contract. According to the grade of impact and importance, considering the specialty of school projects, the criterion of defining defects of service quality is like below **Table 1**.

From **Table 1**, the defects can be classified into four ranks per importance. Rank A is urgent defects, which impact education as the key activity in schools. Rank B is high prior defects, which interrupt the usage of educational function or unavailable in key departments. Rank C is middle priority, which has no immediate impact, will cause only small inconvenience or interruption to education crew or students, or are unavailable and in middle important or non-important department. Rank D is low prior defects, which cause no immediate or potential impact to users of building and school, or they are not likely to turn to Rank A,B,C, if no rectification within short time.

Table 1. Criterion of defining defects of service quality

Rank of Defect	Criterion of defining defects of service quality
A: Urgent	a) serious adverse impact to education activity if no immediate rectification
	b) serious damage to building or main function area
	c) to cause sequent impact if no immediate rectification
B: High priority	a) continuous interruption, OR to interrupt the usage of education function if no rectification within defined period.
	b) turn to Rank A if no rectification within defined period.
	c) defects raised due to unavailable and in key education department
C: Middle priority	a) no immediate impact to users of building, if no rectification within 24 hours
	b) cause only small inconvenience or interruption to education crew or students
	c) cause only small inconvenience or interruption to education crew or students, if no rectification within 24 hours
	d) defects raised due to unavailable and in middle important or non-important department
D: Low priority	a) cause no immediate or potential impact to users of building and school
	b) no likely to turn to Rank A,B,C, if no rectification within one week

Table 2. Time Frame to rectify defect of service quality

Rank of Defect	Reaction	Completion
Rank A	5 Minutes	30 Minutes
Rank B	30 Minutes	2 Hours
Rank C	60 Minutes	24 Hours
Rank D	60 Minutes	4 Days

For sure, if one quality defect cannot be rectified within limited time, then its impact will increase (Kumari, 2016). Therefore, besides above criterion of defining defects of service quality, rectification time must be standardized, refer to **Table 2**. The defect will upgrade, if the responsible party cannot react within defined time period or cannot rectify the defect within defined time period (Sastoque, 2016). For instance, a defect of Rank D will turn to Rank C, if it cannot rectified within 4 days. This defect will turn to Rank B if it cannot be rectified for example within next 24 hours.

To judge the defect of service quality, and to supervise the rectification, is not be executed by public sector itself, but by a special "task force" appointed together by public and private sector (Roehrich, 2014). This task force will do fair and transparent judgement. The main task of this "task force" is to notify to stakeholders of the defect occurred, to classify the rank of the defect, to supervise the rectification, to record and report the progress of rectification.

QUANTIFY THE IMPACT FROM DEFECT OF SERVICE QUALITY

After standardize the defects of service quality in school, it is possible to define the defect number and impact rank, within a certain time period. How to quantify the loss from the defect, and how to link to the governmental subsidy, one mechanism and model is required to measure the quantification of defect impact, or in simple called "monetization"(Gurn, 2016).

In this quantification model, every defect in different rank will relate to different score. In detail, enumeration method can be used to define score of different defect of service quality (Gestel, 2014). And all these will be written into the service standard. **Table 3** presents the logic of giving scores of defects. Column means the rank of defects, i.e. Rank A, B, C, D from urgent to low priority. Line means importance degree of impacted area, like education activity is the most important, while administration is least important in school. If defect of service quality impact directly education activity, then this defect has high weighting. In sequence, educational associated function, normal supporting function and backstage administration will have decreasing weighting. This table form

Table 3. Score of defect of service quality

		Function Department			
		Education Activity	Educational supporting	Facility/normal supporting	Administration
Defect Rank	A Urgent	10	9	8	7
	B High Prior	9	8	7	6
	C Middle Prior	8	7	6	5
	D Low Prior	7	6	5	4

Table 4. Total score of defects and related multiplier factor for deduction

Total score of all defects (monthly)	Multiplier factor for deduction calculation
1-10	0%
11-25	0.1% for each score
26-40	0.2% for each score
41-60	0.3% for each score
> 60	0.4% for each score

a weighting matrix of the defects of service quality. The higher the rank is, the higher score the defect will get. The closer to key function of school, the higher score the defect will be given.

The "task force" can be appointed to record every defect and classify them, in order to get related score of each defect, to be the base of deduction from governmental subsidy (Khadaroo, 2014). These record can be put into monthly report, to be application appendix for monthly payment.

For instance, during a class, the power of electrical touch-panel interrupts. According to defect rank, this is urgent, because it stops the ongoing education activity. So it is Rank A. From another view, this defect happens in the key department, i.e. education activity. From above **Table 3**, this defect has the score of 10.

Another example, the elevator in the teaching building is out of service and it hinders the student to visit class, who may have leg problems. This defect does not impact education activity, but cause inconvenience to users. So it belongs to Rank C. From another view, this defect does not happen in education activity or educational supporting department, but in normal supporting function. So from **Table 3**, this defect will be given the score of 6.

DEDUCTION MECHANISM OF GOVERNMENTAL SUBSIDY BASED UPON DEFECT SCORE

For PPP school projects, the project payment can be annual, quarterly or monthly. Normally, school project has big capital investment. In order to attract private investment, and to help investor to refinance early, also to avoid much financial cost to the project, government usually give monthly payment.

The same as payment, governmental subsidy can be paid in the same rhythm as monthly payment. For an easy execution, governmental subsidy can be figured out from monthly service payment.

The amount of monthly payment is like the base for the calculation of governmental subsidy. Through above standardized weighting system, we can get score of each defect, and then the total score of all defects. With the total score, a ladder-like deduction model can be designed, like **Table 4**. Different score range will have different deduction factor. The higher the score is, the bigger factor the deduction will have.

For instance, the monthly total score of all defects of service quality is 28. Then the subsidy deduction in that month is equal to 2.1% of monthly payment. The 10 score of 28, each score will have a multiplier factor of 0%.

The 15 score of 28, each score will have a multiplier factor of 0.1%. The 3 score of 28, each score will have a multiplier factor of 0.2%. Then the calculation is like 10*0% + (25-10)*0.1%+(28-25)*0.2% = 2.1%.

Therefore, the deduction of monthly governmental subsidy and governmental subsidy can be represented with below formulas：

$$Sa = MSP \times 2.1\% \tag{1}$$

$$Sp = Sn - Sa \tag{2}$$

S stands for Subsidy，Sa stands for Subsidy Abatement, MSP is the abbreviation of Monthly Service Payment. Sp stands for practical subsidy. Sn stands for nominal subsidy, which is calculated when signing PPP contract. Practical subsidy is equal to nominal subsidy minus subsidy abatement.

Time factor of rectification is important to consider. If a defect of service quality cannot be rectified within short time, the impact of the defect will expand. To encourage private partner to react quickly, a multiplier factor of timing should be added into the formula, to calculate the subsidy deduction. The purpose of this factor is to warn the SPC/private partner, to rectify the defect quickly. The longer the correction takes, the bigger the deduction will be. Then this timing factor t>1. Above formula (1) turns to below formula (3), considering timing factor.

$$Sa = MSP \times 2.1\% \times t \tag{3}$$

Seeing from the **Table 2** "Time Frame to rectify defect of service quality", defects of Rank A should be corrected within 30minutes. If the SPC complete the correction after 120 minutes, then the timing factor t = 4（=120/30）.

However, subsidy deduction due to service defects need to have a ceiling value. The value can be set according to negotiation when signing PPP contract of the school. One reasonable ceiling value is the value of monthly payment. It means the subsidy deduction of this month cannot reach or higher than monthly payment. The formula is like below.

$$Sa \leq MSP \tag{4}$$

In practical, this setting of ceiling value is also reasonable. The service for the whole month must have added value, so the return should not be zero but positive.

Of course, during the research of this deduction mechanism, all the factors like defect rank, rectification time frame, defect score, multiplier factor, payment base, ceiling value, etc., are not unique, but changeable per different PPP projects or schools. However, before the execution of contract, all these factors must be fixed by means of mutual agreement and in written form in PPP contract, which is the bible of governmental subsidy. Different PPP schools can have different deduction mechanism.

GOVERNMENTAL SUBSIDY BASED UPON STAKEHOLDERS' SATISFACTION

The second methodology, the research of governmental subsidy is based upon main stakeholders' satisfaction of the service quality in PPP public schools.

THE BALANCE OF STAKEHOLDERS' SATISFACTION

In PPP Public schools, besides public and private sectors who are partners, another key stakeholder is the social public (Aarseth, 2016). Hence, to study main stakeholder's satisfaction, is mainly to study on public sector, private sector and the social public's satisfaction (Torvinen, 2016). According to the change of these three parties' satisfaction to service quality, the government can adjust the value of subsidy. Of course, the subsidy value itself is one of factors impacting these three parties' satisfactions.

Table 5. Questionnaire feedback of key factors and weighting to impact satisfaction

Key factors	Public Sector	Private Sector	Social Public
	Weighting of impacting satisfaction		
F1 Project Quality	0.082	0.078	0.083
F2 Quality of public service	0.070	0.071	0.076
F3 whether to get governmental or other subsidy	0.052	0.067	0.059

Refer to the study from Dr. DENG Xiaopeng in 2009, the most important factors related to service quality is the quality of the project itself (F1), the quality of the public service itself (F2). Because three parties have different position, they have different concern on these two factors. In another word, these two factors (F1, F2) have different weighting to three parties, when quantifying their satisfaction. The same, whether private sector can get public subsidy or other subsidy (F3) has different weighting to three key stakeholders' satisfaction. Through the scoring of these three factors (F1, F2, F3) and the weighting to three parties' satisfaction (from questionnaire, see **Table 5**), to calculate the change of three parties' satisfaction, to compare their change degree. Through the value adjustment of governmental subsidy, to reach a balance that three main stakeholders have the same satisfaction (quantified).

The adjustment of satisfaction is dynamic. Based upon the adjustment to balance satisfaction, project quality (F1) and to deliver a service with high quality (F2) keep changing in the progress of project. In this model, F1 and F2 are assumed to be self-changing variable. In correspondence, the change of governmental subsidy (F3) is the dependent variable.

SCORING METHODOLOGY OF THE CHANGE OF SATISFACTION INDEX

Whether a project has good quality F1, can be judged by many index, like construction acceptance rate, ground foundation acceptance rate, main structure acceptance rate (Rashedi, 2016), etc.

To judge the quality of public service from School F2, education quality, capability of teachers, acceptance rate of high school, etc. are index.

To calculate the scoring of the change of governmental subsidy, practical data can be analyzed in formula (5)：

$$f_{\Delta j}^{i} = 100(Xi\text{-}Yi)/Yi \qquad (5)$$

For instance, j=3, $f_{\Delta 3}^{i}$ stands for the scoring change of F3 in the year of i; Xi stands for the practical value of governmental subsidy in year i, and Yi stands for the planned value of governmental subsidy in year i.

The same, if j=1, $f_{\Delta 1}^{i}$ stands for scoring change of F1 in the year of i; Xi stands for the practical project quality in year i, and Yi stands for the designed project quality in year i.

If j=2, $f_{\Delta 2}^{i}$ stands for scoring change of F2 in the year of i; Xi stands for the practical service quality in year i, and Yi stands for the planned service quality in year i.

MODEL FOR BALANCING SATISFACTION THROUGH ADJUSTMENT OF SUBSIDY

The principle is to find out the satisfaction difference among three parties, through the calculation of three parties' satisfaction value in the year of i. In order to balance the three parties' satisfaction i.e. to make them same satisfied in the next year, the model will adjust the governmental subsidy in the year of i+1 (Willems, 2014).

From data collection through questionnaire feedback in above **Table 5**, key factor Project Quality (F1) and Quality of public service (F2) have their related weighting. Through the formula (5), $f_{\Delta 1}^{i}, f_{\Delta 2}^{i}$ can be calculated (the scoring change of F1, F2).

With above weighting in **Table 5** and scoring change of F1, F2, the change of three parties' satisfaction can be calculated respectively. Formula (6) shows the calculation of satisfaction change of three parties in the year of i.

$$\begin{cases} S^i_{\Delta gov} = 0.082 * f^i_{\Delta 1} + 0.070 * f^i_{\Delta 2} \\ S^i_{\Delta pri} = 0.078 * f^i_{\Delta 1} + 0.071 * f^i_{\Delta 2} \\ S^i_{\Delta pub} = 0.083 * f^i_{\Delta 1} + 0.076 * f^i_{\Delta 2} \end{cases} \tag{6}$$

In formula (6), S stands for Satisfaction, Δ is the change delta, gov means government, $S^i_{\Delta gov}$ stands for the satisfaction change of public sector in year i. The same, $S^i_{\Delta pri}$ means the satisfaction change of private sector in year i, $S^i_{\Delta pub}$ stands of the satisfaction change of social public in year i.

Then the average change of three parties' satisfaction can get from formula (7).

$$S^i_\Delta = 1/3(S^i_{\Delta gov} + S^i_{\Delta pri} + S^i_{\Delta pub}) \tag{7}$$

The aim is to make three parties having the same level of satisfaction. After adjustment of governmental subsidy in the past year, at the beginning of the next year i, theoretically three parties should have the same satisfaction. From this base, in order to make three parties having the same satisfaction level at the beginning of year i+1, three parties should have same change of satisfaction, i.e. S^i_Δ. From satisfaction base at the beginning of year i, plus average change of satisfaction change of the three parties, the scoring change of governmental subsidy $f^i_{\Delta 3}$ can be figured out by formula (8).

$$0.052 * f^i_{\Delta 3} + 0.067 * f^i_{\Delta 3} + 0.059 * f^i_{\Delta 3} = 3 * S^i_\Delta \tag{8}$$

With the value of $f^i_{\Delta 3}$, the subsidy value of governmental subsidy in the year i+1 (Subsidy$_{i+1}$) can be figured out, through below formula (9)

$$Subsidy_{i+1} = Subsidy_i * (1 + \frac{f^i_{\Delta 3}}{100}) \tag{9}$$

CONCLUSION

For public school where PPP is applied, in the model of quantifying defects of service quality, after research, we can see governmental subsidy and quality defects are in inverse proportion, while subsidy deduction and quality defects are in direct proportion. All these are related to defect frequency, times, rank, impacted department, time frame of rectification, payment base, etc. This model has not developed complex mathematics formulas, but starts from standardized service, defect type, rank, time frame, deduction multiplier factors, etc, to research the relationship between governmental subsidy and service quality at public school where PPP is applied.

In the model of balancing stakeholders' satisfaction of the service which school delivers, satisfaction of public section, private sector and social public are studied. Here governmental subsidy is the only dependent variable, which is used to balance the three main stakeholders and their satisfaction.

Both models study on the same variable, i.e. "service quality", which impact governmental subsidy. In School project, service quality is mainly related to both educational activity and facility. Besides service quality, both models can be further used to study the relationship between governmental subsidy and its other variables. And all the studies serve the only target, to facilitate the promotion of PPP (Public Private Partnership) at public schools, to serve the whole society.

REFERENCES

Aarseth, O. A., Urdal, V. M., Bjørberg, S., Støre-Valen, M., & Lohne, J. (2016). Ppp in public schools as means for value creation for user and owner. *Procedia - Social and Behavioral Sciences*, *226*, 398-406. doi:10.1016/j.sbspro.2016.06.204

Amjad, R., & Macleod, G. (2014). Academic effectiveness of private, public and private–public partnership schools in Pakistan. *International Journal of Educational Development*, *37*(4), 22-31. doi:10.1016/j.ijedudev.2014.02.005

Chattopadhay, T., & Nogueira, O. (2014). Public–private partnership in education: a promising model from Brazil. *Journal of International Development*, *26*(6), 875-886. doi:10.1002/jid.2930

Cruz, N. F. D., & Rui, C. M. (2012). Delivering local infrastructure through ppps: evidence from the school sector. *Journal of Construction Engineering & Management, 138*(12), 1433-1443. doi:10.1061/(ASCE)CO.1943-7862.0000558

Hare, P. (2013). PPP and PFI: the political economy of building public infrastructure and delivering services. *Oxford Review of Economic Policy*, *29*(1), 95-112. doi:10.1093/oxrep/grt007

Khadaroo, I. (2014). The valuation of risk transfer in uk school public private partnership contracts. *British Accounting Review*, *46*(2), 154-165. doi:10.1016/j.bar.2013.12.004

Kumari, J. (2016). Public–private partnerships in education: an analysis with special reference to indian school education system. *International Journal of Educational Development*, *47*(3), 47-53. doi:10.1016/j.ijedudev.2015.11.017

Gestel, K. V., Willems, T., Verhoest, K., Voets, J., & Garsse, S. V. (2014). Public–private partnerships in Flemish schools: a complex governance structure in a complex context. *Public Money & Management, 34*(5). 363-370. doi:10.1080/09540962.2014.945808

Gideon, J., & Unterhalter, E. (2017). Exploring public private partnerships in health and education: a critique. *Journal of International & Comparative Social Policy, 33*(2). doi:10.1080/21699763.2017.1330699

Gurn, A. M. (2016). Courting corporate philanthropy in public education: multi-disciplinary literature review of public-private partnerships (ppps) in urban public schooling. *Sage Open*, *6*(2). doi:10.1177/2158244016635714

Rashedi, R., & Hegazy, T. (2016). Strategic policy analysis for infrastructure rehabilitation using system dynamics. *Structure & Infrastructure Engineering, 12(6)*, 667-681. doi:10.1080/15732479.2015.1038723

Roehrich, J. K., Lewis, M. A., & George, G. (2014). Are public-private partnerships a healthy option? A systematic literature review. Social Science & Medicine, *113*(7), 110. doi:10.1016/j.socscimed.2014.03.037

Sastoque, L. M., Arboleda, C. A., & Ponz, J. L. (2016). A proposal for risk allocation in social infrastructure projects applying ppp in Colombia. *Procedia Engineering*, *145*, 1354-1361. doi:10.1016/j.proeng.2016.04.174

Torvinen, H., & Ulkuniemi, P. (2016). End-user engagement within innovative public procurement practices: a case study on public–private partnership procurement. *Industrial Marketing Management*, *58*, 58-68. doi:10.1016/j.indmarman.2016.05.015

Verger, A., Bonal, X., & Zancajo, A. (2016). What are the role and impact of public-private partnerships in education? A realist evaluation of the chilean education quasi-market. *Comparative Education Review, 60*(2), 000-000. doi:10.1086/685557

Willems, T. (2014). Democratic accountability in public–private partnerships: the curious case of flemish school infrastructure. *Public Administration, 92*(2), 340–358. doi:10.1111/padm.12064

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