Supply Chain Gain/Pain Sharing Contracts with Asymmetric and Full Transparency

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Abstract

This case study investigates a subcontractor's multi-year service contract agreement with a primary contractor. The subcontractor used lifecycle costing methodologies to estimate future costs. To motivate cost saving, a gain-sharing percentage was proposed by the primary contractor. The subcontractor had no visibility of margin/terms between the primary contractor and client. The contractual terms motivated the subcontractor to mitigate the risk of cost overrun by artificially inflating the contract price from sub-suppliers with a rebate. Simulation of full and asymmetric information show that the subcontractor should receive 90% of the gain-share for assuming all pain risks.

Keywords: Gain/pain sharing; Supply chain contracts; Service.

Introduction

This case study involved a subcontractor in the construction industry that engaged with a large construction company (the primary contractor) to offer an annually recurring service to repair/replace all assets in contractual scope. It does this by charging annually invoiced fees to the primary contractor; the cost of which are derived from a lifecycle forecasted model that attempts to predict asset replacement costs and timing. These forecasts help calculate the annual expected budgets that are agreed for the duration of the contract. If there is underspend (review every three-year), then both parties split the savings according to a pre-agreed gain-share percentage. Furthermore, with only pain-sharing agreement, it means all the overspend, if budget for the same three-year period is exceeded, is absorbed by the subcontractor. The contract is structured as a cost plus a fixed seven percent margin for the subcontractor – as the entire incentive for the primary contractor using the subcontractor is the market expertise and buying power of the subcontractor. However, as the primary contractor gave no indication of the financial arrangement between themselves and the end-client, the relationship is asymmetric in nature when it pertains to visibility entire supply chain costs and profits.

This paper first reviews the existing literature on gain/pain-sharing or similarly structured incentive-based agreements. We attempt to understand structure of the

contractual agreement that led to outcomes benefiting a party or the end-to-end supply chain. Here we investigate why a subcontractor – or any party - would volunteer such an arrangement in the first place. What are the caveats and potential pitfalls that influence each party's negotiating terms? If the supply chain were to have full transparency, does that make gain/pain-sharing agreeable and beneficial to all parties involved; or does it give rise to other issues?

The second part of this case study investigates how the subcontractor - with limited visibility of the overall supply chain's operating cost - attempted to safeguard risk exposure and justified the agreed distributions of future gains and pains. This case study first identifies strategies used by the subcontractor to help protect themselves at the expense of the overall supply chain. Then, this paper simulates likely contractual distribution of profit in these strategies and compare them to the envisaged outcome without such behaviours. With these simulations, we investigate whether there are ways to mitigate these behaviour through different contractual terms or at least forecast expected returns for the strategies being used. This will serve as a method of investigating whether risk is shared appropriately in this case study.

Literature Review

The sub-contractor basically offers a multi-year service contract to maintain or replace assets in a building owned by the client through a primary contractor. Similar contracts are used for servicing production equipment for factories, whereby the client could pay a fixed fee over the useful life of the asset (with a penalty clause for failing to repair the asset), or to pay a fixed cost per inspection/repair whenever there is a need, or to do maintenance by themselves (Ashgarizadeh and Murthy 2000; Murthy and Ashgarizdeh 1999; Wang 2010). The outcome of such contracts depends on the failure rate and intensity of the assets (Jackson and Pascual, 2008), and uncertainties in the future costs for repair or replacement. In terms of the continuum of outsourcing, such service contracts sit between maintenance being carried by the clients (Wang 2010) and the use of an availability contract without ownership of the asset (Settani et al. 2014). In each circumstance, efforts invested by the client and contractors to maintain the assets may vary, which in turn will affect the asset failure rates and future cost for repair and replacement. For example, putting off the replacement of a specialist piece of equipment could mean replacing an entire machine when it breaks, incurring costs that are many times more costly than a scheduled maintenance visit by the subcontractor. Because efforts are harder to verify than outcomes (Corbett et al., 2005), incentives such as gain-sharing are included into such contracts.

Very often such service maintenance contracts for future years involve heterogeneity or a non-identical distribution of risks for the subcontractors and the owners (Buourles and Henriet 2012). The distribution of risk could be compounded by agency problems such as hidden actions or moral hazard that occur under instances of asymmetric information (Corbett et al. 2005). There will often be some information asymmetry between supply-chain parties. However, so long as there are transparent ways of predicting equal outcomes between parties – namely in a two-agent model – gain-sharing may be able to work as long as the forecast methodology is approved and verified by both parties (Bourlès & Henriet 2012). The level of information shared between parties can remain somewhat anonymous, so long as the financial risk model uses accurate and agreeable financial and life-cycle estimates. It is not vital to involve or even know the manufacturers that the subcontractor uses as long as the prices and

expected life for each SKU is agreeable. If the gain-share is calculated on a time-based budget, then the variability or underspend that may occur would come from lifecycle estimates being inaccurate, the price of the good changing, or chance (the forecast being wrong).

By keeping contractual obligations to "fit-for-purpose" instead of specific model numbers the subcontractor and primary contractor can avoid supplier risk by allowing them to tender or source from multiple suppliers of the same product; serving as a contingency plan, a way of reducing expenditure, and handing the primary contractor the subcontractor's relationships and procurement prices. In situations where all costs are transparent from the supplier to the primary contractor it would be easier to validate fairness and profit distribution, but in most situations, there is hidden information, and some of this hidden information can affect the "fairness" of contractual terms.

Varying risk attitudes might affect the choice of service contracts. A risk-averse agent would transfer risk to a risk-neutral party (Hosseinian and Carmichael 2013). In the construction industry, some clients prefer a target costing contract (TCC) with a fixed lump-sum price so that the risk of additional cost is passed on to the contractors (Chan et al. 2010a). However, the clients are also aware that this type of contract motivates contractors to allocate extra contingency cost for accommodating scope change, fluctuation in material cost, late-delivery penalty and other sources of cost variation (Chan et al. 2010b). To incentivize contractors to save cost, the construction industry often adopts a TCC whereby a fixed target cost is set based on given parameters at the outset of a project; if the fixed target cost is fallen short of or exceeded, the financial gain/pain is split between the contract parties in accordance with a pre-agreed share ratio. Thus, TCC in construction covers both gain and pain sharing.

Businesses can manage these risks in a variety of ways. However, in gain-share agreements, that mark-up is a percentage that is usually agreed up-front with the primary contractor. As these frameworks are built on trust, there must be an auditable process that allows the primary contractor to verify the price being paid by the supplier is sufficiently low. Even though the primary contractor may be able to ask for transaction data from the subcontractor, the entire relationship between subcontractor and their supply chain cannot be visible because it may compromise the unique selling points of the subcontractor. Because of this, risk can still be hedged "invisibly" by the subcontractor via overarching company-wide rebate agreements with their own supply chain (Taylor 2002).

Existing rebate agreements with supply chain on business-wide scope are very difficult to regulate as no business would agree to be completely transparent in relevant parts of their supply chain, i.e. companies that fall within contractual scope. Going further down the supply chain levels is also problematic as subcontractor's supply chain partners are unlikely to want to show what their actual manufacturing costs are. Another risk to the subcontractor is the chance that by opening up price visibility of its suppliers, the suppliers may have direct access to the primary contractor as a direct sale opportunity and completely bypass the subcontractor-reseller (Li et al. 2014). Because of this, gain-share cannot reasonably extend to the manufacturer level in a supply chain deeper than two levels because there is no incentive for the manufacturer to reduce the mark-up for the purpose of getting a percentage of the amount saved over the duration of the contract. There may be justification in a one or two-layer supply chain as loss-leading can be utilised in smaller contracts to establish a relationship for more profitable contracts in the future (Bliss 2013). However, beyond two layers, the

gain-share agreement should stop short of the manufacturer as the benefit to entering a gain-share is greatly reduced for manufacturers and risk direct sourcing from manufacturer to primary contractor may impact the subcontractor if too much is made transparent.

Furthermore, all tiers in the supply chain also must have capacity to verify that their supply chain isn't inflating costs superficially to benefit themselves. In a rebate contract in the healthcare industry – where the reimbursement works similarly to a gain-share mechanism – resource for "specialised legal, technical, and administrative personnel for contract negotiation, monitoring and enforcement" was necessary to "ensure that reasonable and equitable contract outcomes – namely prices – are achieved across payers (Morgan et al. 2013, p.773). This exercise can be very costly to businesses and could negate the benefit of the gain-sharing mechanism. Ignoring this exercise of data interrogation results in a relationship of businesses built entirely on trust.

Finally, it must be noted that there are instances where businesses - or individuals in that business - are overly eager for opportunities can act more like individual decision makers than as a complete business (Fiegenbaum & Thomas 1988). Bowman (1982) described this behaviour as occurring in troubled companies, where they have tendencies to overextend themselves in regard to risk. Additionally, by extending the findings by Staw (1982) who observed that firms that are below their financial targets are more likely to escalate engagement, the desire of individual stakeholders that work inside the firm may be more willing to assume risk in the long-term if it ensures that their own targets are fulfilled in the short-term. Managers "avoid the risk of an uncertain environment by negotiating uncertainty-absorbing contracts" and "performance below a target is argued to lead to greater willingness to take risks, in order to increase the chance of reaching the target" (March & Shapira 1987, p.1410). Therefore, if the subcontractor's negotiator is overeager for business it is important have a method/mechanism to evaluate risk in order to ensure that the subcontractor can still justify contractual terms.

Methodology

The case company being investigated at the commencement of the case study was a furniture re-seller that predominantly sold to academic and commercial institutions. As part of a new service offering akin to the managed service in the IT and facility management sectors, the business sought to expand their offering to include multi-year contractual agreements that would involve the repair and replacement of assets in a given site. In order to accomplish this, the business first performed legacy audits to build up an asset register, take note of asset quantity, quality/condition, and location. From this collected information, equivalent products from the business's supply chain was specified along with price estimates and warranty/expected life estimates. From this the business put together financial forecasts (with a fixed 2.5% inflation rate) for asset replacements and repairs and service charge estimates from the period of 2016-2032.

Over this fifteen year period with gain-share and pain-share calculations taking place at years 3, 6, 9, 12 and 15. If actual expenditure over the three-year periods leading up to each "gain-share" year had a net expenditure over the total budget for that period, then pain-share would be distributed according to contractual specification. If expenditure for the period was under the total budget for that period, then the underspend value would be divided between the subcontractor and primary contractor as per contractual specification. This exercise carries on over the course of the contract

until the end of the 15th year. The annual budgets were calculated based on a cost + margin (7%) percentage that was agreed between the two parties during negotiations.

Because there is a lack of full transparency in overall project margin – the methodology used above for evaluating subcontractor's risk is structured with the transparent profit margin (cost + 7%) in mind. The rationale for this is that if the primary contractor is not disclosing the margin that they are making, there is reason to assume that they are happy with the new contractual arrangement, otherwise they would not be engaging with the subcontractor at all. Therefore, the subcontractor's interest serves as the stake in the ground for what the appropriate distribution of gain and pain is for the contract.

Data about the contract were collected by a researcher embedded in the subcontractor organization as he was involved in costing the contract. The embedded researcher obtained unique insight by participating in meetings and contractual negotiations that took place over the course of 12 months. Notes were taken during these meetings and financial modelling adjustments were catalogued and stored throughout the course of the contract until the primary contractor ceased to do business. These notes on subcontractor strategies and considerations are of interest especially as it pertains to arriving at contractual terms.

Unfortunately, the contract ceased to be enforced from 2018 onwards because the primary contractor involved in this paper went into administration. Thus, simulation methods are used to evaluate the risk exposure the subcontractor assumed given several permutations of scenarios. Furthermore, following the simulation, the paper will discuss the strategies utilised by the subcontractor in order to mitigate risk exposure to themselves as it pertains to agency theory and the potential for misaligned goals in the contract.

Methodology in Simulating the Contractual Terms

In order to simulate the outcome of the agreed contract gain-share percentages there are a variety of variables to define, after which explanation into the methodology for the simulation will be described. It must be noted that there are more parameters that could be used to influence the outcome of a cost prediction for an asset; there are too many to list so this case study will focus solely on the ones used by the subcontractor. However, more accurate models may be derived in the future with more accurate predicting power than the one constructed in this case study. The accuracy for the two years of financial records that the business had in dealing with the main contractor was over 90%, the highest being 94.1% and the lowest being 82.3% across three contracts. Variables at play in this model are:

- Gainshare Percentage
- Painshare Percentage
- Transparent Profit Margin
- Expected life of asset (SKU)
- Expected Cost to Repair/Replace

Gain/Pain calculations take place every three years as previously mentioned. the transparent profit margin is made by the subcontractor until the annual budget for that year is met. After-which painshare is incurred at contractually agreed rates at the end of the three year period if the cumulative expenditure is exceeded. And additional profit is

split amongst the primary and subcontractors at contractually agreed gainshare rates if costs are delivered below the three year total. This exercise is continued until the contract would expire. Cumulative profit margin is then tracked throughout the duration of the contract, at which point overall profit margin is calculated for the entire period.

In order to simulate the contractual terms, we take the pre-agreed annual budgets and calculate a semi-random estimated cost by multiplying each year's budget against a percentage that falls between 0 and a ceiling percentage. This percentage was chosen arbitrarily by a python library that allows one specify the range between which you want a number to be chosen from. The method of choosing the random number is unimportant. There ways of weighting the randomness to be derived from a more bell shaped curve of distributions but in order to take out any potential bias' a uniform "randomness" was used in this case study.

We repeat this *n* times at each combination of *floor* and *ceiling* that we wish to analyze as well as each distribution of gain/pain share distribution that could be agreed. *Figure 1* shows four combinations of *floor and ceiling* variations at each gain/painshare distribution in intervals of 10%. The values in each individual square is the profit margin returned at two standard deviations to the right of the mean of *n* simulations.

Findings

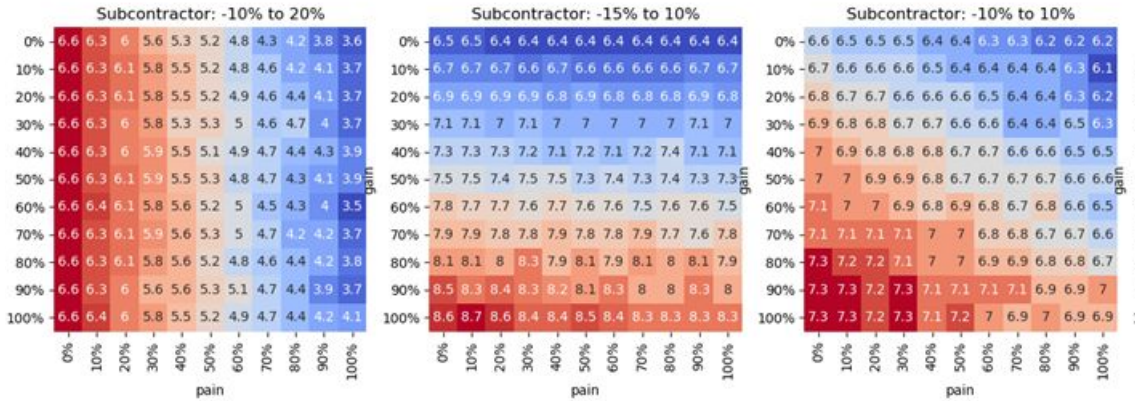

Figure 1

By using this methodology, it is possible to justify gain and pain-share amounts agreed during negotiations - the subcontractor gaining 40% of the profit in periods of underspend, and 100% pain when overspending - by using this simulation method if the subcontractor is confident that there is a greater possibility that there will be underspend in a given period than overspend. In Figure 1 above, it is possible to see for example that if the subcontractor believes that expenditure could fall 15% below the annual cost but could also realistically exceed the budget by 10%, then the minimum amount of gain-share they should accept is 30% even if they were to accept all of the pain risk as that is the point where the simulated profit is 7%, the same amount that was agreed upfront with the primary contractor. However, in all scenarios where there is equal likelihood of the estimation being inaccurate in the other direction, where overspend is equally likely or more likely than underspend, the model shows that the subcontractor would not be able to justify the contractual terms that they agreed in reality (40% gain/100% pain).

As it pertains to the case study in question, transparency into these adjustments and assumptions were instrumental in agreeing a service contract between subcontractor and

primary contractor. Without having transparent discussions about how financial figures were being estimated, the primary contractor would not have signed onto multi-year service agreements for assets that could "potentially have such wildly variable lifespans". The primary contractor was consistently hesitant with how figures could be reduced by tens of thousands of pounds by adjusting assumptions and introducing caveats but through transparency and discussion about what adjustments were made, the act of gain-sharing was made possible.

The subcontractor never positioned itself strongly in regards to sharing "pain" if budgets were exceeded. One of the project leads for the contract stressed that the primary contractor would not be interested in the proposition if risk was introduced on their end. From the meetings and interactions that the researcher was exposed to, the rationale for choosing to take 100% of the risk was a three-pronged justification.

1. They felt that they had built in a safe amount of expected life per asset in the model that was justifiable for the cost model but safe for the given amount of transparency in regards to passing on "cost price" to the primary contractor.
2. The employees involved in the process were more interested in getting a contract with the primary contractor signed so that it could open the subcontractor to more lucrative contracts in the future, so a loss-leading strategy was discussed in the event the model forecasts were radically different to reality.
3. The primary contractor knew the relative size of the subcontractor in relation to itself and due to this was able to more heavily influence negotiations. As the annual budgets were reduced through several rounds of negotiations by the primary contractor, the subcontractor had less bargaining power for introducing risk to the primary contractor.

Discussion and Conclusion

This model has several limitations/assumptions that can influence the outcome of the subcontractor's profitability. Firstly, this model assumes a level of information opaqueness, meaning that if the subcontractor is able to secure the same product more cheaply, that new price is auditable but does not impact the already agreed annual budget amounts.. Therefore, for the same reason, rebate agreements that may be in place between the subcontractor and the supplier are "invisible" in the sense that the model does not account for rebate agreements to boost profitability in a given year via any calculation. This provides opportunity for others to expand upon this forecasting methodology to incorporate additional factors that may influence expenditure whether they be internal or external supply chain risks. However, this model still allows subcontractors to presuppose rebate agreements or finding alternative suppliers by setting the f (floor) value lower; making the model assume that you have a higher likelihood of coming in under the budget in a given year. Similarly, if a supplier in your supply chain has a high stock-out risk that may cause you to go to a different more costly alternative product, then the c (ceiling) value can be set higher to account for situations when the budget is more routinely exceeded.

The Case for Full Transparency: The Entire Picture

In the case study being examined, the transparency of profit margin is asymmetric; the subcontractor has an established and visible profit margin that is auditable by the primary contractor when they choose to view it. However, the subcontractor is not privy to the profit margin made between the primary contractor and the client. Therefore,

there is no certainty in ensuring that the subcontractor is benefiting more or less equally than the primary contractor in a gain-sharing agreement. In future negotiations, the subcontractor should endeavour to gain access to the overarching contractual agreement in the interest of fairness and risk distribution, but in this case - because of the willingness to accept the primary contractor's terms for the award of the contract – that information was not available. This lack of information makes it impossible to ensure equal sharing of profit in gain-share events and equal sharing of pain in pain-share events. That is not to say that profit should necessarily be equal between parties of this agreement structure, rather the subcontractor should try to gain access just to ensure that they are not being exploited by the larger primary contractor. The lack of transparency in this case inspired the subcontractor to look for overarching supply chain rebate agreements to offset the low margins that were agreed with the primary contractor in this agreement. Though, it is likely that this behaviour would have occurred regardless of whether they had visibility or not.

Though the subcontractor may benefit from these contractual terms, especially when using rebates to receive additional cash flows to supplement the risk, without knowing whether the client has any visibility of the contract being discussed between the primary contractor and the subcontractor, there is no guarantee that the primary contractor's payment terms with the client change at all following this agreement. While this is irrelevant to the subcontractor, in the interest of actually providing a cheaper service to the end user/client, they still may be spending the same amount of money than they would have before the new contract was signed. If the end goal is to actually improve the overall bottom line of maintaining the school by bringing in a specialist subcontractor, the agreement needs to extend one more level to the client. Without it, there is no guarantee that the client benefits at all monetarily. If the client is involved in the gain/pain-share arrangement then there is opportunity for them to pay less than they were actually intending to pay due to the gain-share mechanism. With the opportunity of receiving gain-share, the client would have to assume some additional risk of exceeding budget due to supply chain inefficiencies or issues. This risk is what would inspire all three parties to endeavor to reduce overall costs, prioritizing repair over replacements and to be as economically responsible as possible in order to reduce the risk of incurring "pain" and increase the chance of receiving "gainshare" when delivering under budget. As it stood in the case study, the primary contractor had no real "risk" as their annual contract amounts served as the ceiling for the most they would ever pay. There would be no incentive for them to try to maintain existing/older assets when they could just have the subcontractor supply them with a new product.

Without complete transparency throughout the entire supply chain, the issues identified by Chan in regard to building in small margins into costs to help safeguard subcontractors occurred throughout the duration of contract negotiations. Strategies for mitigating risk were heightened in this case due to the nature of the contractual agreement; the time invested from a human resource point of view would likely not have been spent by the subcontractor had the primary contractor assumed some pain share risk. It is unfortunate that the primary contractor collapsed and the scope of this case study was so drastically shortened. The subcontractor failed to simulate best and worst case scenarios in regard to risk exposure and largely tried to reason out ways of managing the risk they had agreed to. In better circumstances in which there is transparency throughout the supply chain and risk can be shared amongst parties, there is still justification from using a gain/pain share model. But without relatively

appropriate distribution of risk, the subcontractor in this case study should not have given away such a significant portion of gain-share for the amount of potential financial penalties they would have incurred had they significantly underestimated the maintenance costs for their service.

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