

## Principal-Agent Stories from ISYE 6230 Spring 2003 Students

1. Previous to joining Tech for my masters, I was a business communication executive in a popular printing company. My job was space selling. Hence I was the agent and my manager was principal.

The base salary was fixed irrespective of the efforts put in. However, in the incentive scheme, there were quite a few of them like getting 10% sales, highest sales in a week.

This falls into principal-agent framework, as the manager wanted to increase our sales so that company profits would increase. We as agents wanted to get as much salary and use least effort. Potential conflicts in the motives arise in the usage of the agents' effort.

2. In my recollection, a Principal-Agent problem that I can think of is that of a two-man high-tech startup. The owner hired an associate to work on a particular project. The associate was promised a particular wage (\$6000/month) and the promise of a contract extension after the first month, if he was able to deliver a certain piece of code.

The associate (agent) had to utilize his own computer and software for the project. If the code was not delivered, the associate would only be paid \$2000, which would cover his expenses (about \$1000) and his contract would not be extended. Also, he would have to hand over his incomplete code.

This contract is clearly a Principal-Agent problem where the owner is the Principal and the associate is the Agent. As far as conflicts between the two are concerned, it is in the owner's interests to terminate the employee even if he has done most of his work, as that will mean that he saves money and can do the remaining work himself. The employee on the other hand has the incentive to do a months work honestly and then be slack because he will not have to pay his set-up costs more than once for the second month and can get a good payoff even if he is terminated.

3. Before I came to the United States, I decided to sell my car. We took the car to an auto dealer and left it with him to sell. Here is the situation: the car owner – Principal, the deal – agent.

The dealer says that he would take 5% of the sale price of the car. So his payoff is  $\frac{5}{100} \times P_{sale}$ . Dealer has two options. He can try to sell the car by putting some effort into cleaning and maybe repairing some visual defects and getting the higher price for the car or he can just wait for a customer to ask and buy the car by putting no effort into it.

Since I was trying to deal with Visa documentation, I didn't have the time to see what the dealer was doing, so I have only the knowledge of sale price, which is the outcome.

As the principal, I want the sale price to be high, so I would prefer that the agent worked hard. The agent (dealer) can think that without putting much effort, he can sell the car for a high price if the appropriate customer stops by. So the agent may not work hard hoping that a customer with too much money will come by.

Fortunately, my dealer was a hard working person and he sold the car for \$10,000. He gets his \$500 dollars and I got \$9500. If he couldn't sell the car, we would have to take 0 out of the contract.

This is a good example of principal-agent problem because the dealer (agent) takes a decision (work hard or not) that affects his/her utility function as well as the owner (principal) utility. I (principal) have only the chance of observing the outcome, as the dealer (agent) does not necessarily choose the action in my interest.

4. My experience working in a consultant firm is a perfect example of the principal-agent problem. The scenario consists of the following: the managing partner of the consulting firm (principal) and the consultants (agents) rarely saw each other because most of the clients were located overseas and the firm could not send multiple people for every client meeting (also, the managing partner spent much of his time playing golf). Because the consultants did their work at client sites, the managing partner was not there to view their actions. In theory, consultants could skip client meetings or behave in an unprofessional manner. However, the managing partner was able to witness the outcome of the consulting projects (clients would typically recommend the firm to other companies or renew a consulting contract if the project went well). The compensation scenario for the firm was as follows: provide a base salary (which was rather mediocre) and provide large bonuses (as much as 75% of base salary) depending on the outcome of the client projects for which a consultant was responsible. This bonus scheme kept the consultants working hard even when the managing partner was not able to view their actions at client sites. If the firm had paid only a salary regardless of outcome, the consultants could have easily skipped meetings and improved their golf games as well.

5. During the Dot Com era, I worked for Mshift, a Silicon Valley based wireless start-up that developed an integrated development environment (IDE) which allows the development of mobile applications for all types of mobile platforms, such as Palm OS, Symbian, I-Mode, and WAP. While many of the company software engineers “unwired” applications, the core business and focus of Mshift is the enhancement of the IDE. Due to this reason, Mshift considered to outsource the mobile application “unwiring” development to third-party software developers and partners. Software development outsourcing, in general, is playing an increasingly important role in the information technology (IT) strategies of major corporations and attracting the interest of business and technology decision makers across the vertical industry spectrum.

The aforementioned strategy can be viewed as a principal agent problem. In this case, Mshift represents the principal who forms a contract with its agents, the software developers and partners, to encourage the use of its IDE to develop mobile applications for the end user. While the agents can take advantage of the easy-to-use IDE platform to create user-specific applications, Mshift benefits by expanding its user base, brand exposure (“powered by Mshift”), and through revenue sharing plans. Specifically, Mshift provides incentives to its third-party software developers and partners to develop mobile applications. These incentives come in multiple forms. Examples include discounts on future upgrades, free technical support, and advanced partner status. Mshift also benefits if it provides its IDE to agents. First, as previously mentioned, it receives part of the agent's revenues through a revenue sharing program. However, probably more

significant, is the feedback it receives on the usability of its IDE. This feedback can be used to enhance current features and possibly add new ones to a later version. Hence, there is an incentive to Mshift to provide its IDE on a free trial basis or for a significant discount in order to continuously improve its platform. The payoffs for the principal are therefore multifold. Similarly, the agent benefits by replacing traditional mobile application development methods and using a more advanced platform, improving its time-to-delivery and sophistication of applications.

This situation clearly falls under the principal agent framework. The agent “acts” on behalf of the principal and receives incentives for delivering and developing advanced applications, via the revenue sharing program. It can decide how much or little to use the IDE and can play an important role in the enhancement of its product. Similarly, the principal (Mshift) has an incentive to contract “productive” third-party developers and takes on a risk by choosing its partners. Potential conflicts may arise when the principal raises the cost of acquiring the IDE or changes the revenue scheme. The agent also may choose not to use the IDE or move to a competitor’s product. Another conflict may be that the agent develop its own IDE and hence does not require the principals’ product. All this needs to be taken into account when developing the contract and defining the incentives.

6. My friends and I once rented a car in Europe for about a month. It was a small car and the lender gave us a very good deal on the condition that we took good care of it. Since at the time we were very young and there were 5 of us, the lender was afraid that we were going to return the car in “bad condition” afterwards and that we wouldn’t take care of it while driving it since it wasn’t ours. So he clearly and specifically designed a contract in which we would end up paying considerably less as long as we took very good care of the car and returned it in good condition. He specifically laid out a list of things that he would check afterwards (engine, miles, tires, bodywork, interior, etc.) in order to determine whether or not we took “good” care of his car.

This experience clearly resembles the Principal-Agent problem, which can be stated in the following way:

**The principal:** The lender that gave us the car.

**The agent:** My group of friends (we can think of the whole group as a single agent because we all had the same incentives and interests).

**Possible actions:** Our action space is defined by all of the actions that we could have taken with respect to the car. We can summarize all of those actions in two general classes:

1. “Take good care of car” (Actions that lead to returning the car in good conditions: drive slowly, change motor oil every 3000 miles, don’t eat inside the car, drive smoothly, don’t make drastic turns while going fast, don’t put more than 5 people inside the car, etc.).
2. “Take bad care of car” (Actions that lead to returning the car in bad condition: drive fast, not cleaning the car, not changing the oil, put cheap gasoline, basically all of the opposite actions that are in the previous case).

**Possible outcomes:** In this experience we basically had only 2 different outcomes:

- A. Car is returned in good condition. (Clearly this outcome is better for the lender and gives him a higher payoff.)
- B. Car is returned in bad condition. (This outcome is not preferable by the lender.)

**Probabilities of reaching those outcomes:** To each of our set of actions we could associate a certain probability values that such action will lead to either outcome A or outcome B.

For example, if we don't change the motor oil (even as we go over 3000 miles) there is a certain probability that the motor will suffer some damage and that the damage will be so significant that will lead the lender to conclude that outcome B (car is returned in bad condition) has occurred. On the other hand, even if we change the oil accordingly, there is a probability that the motor will suffer damage and that we will end up in outcome B (although this probability should be significantly lower than if we don't change the oil). Values like this could be established for each of the actions. However, this problem could be easier modeled by considering only two actions (take good care, don't take good care) where all of the sub-actions are included in each of those two classes. We would then need to define which set of key actions would define the overall action: take good care, and similarly which would define the overall action: don't take care. Finally, we would compute the probabilities of reaching each of the 2 outcomes by performing each of the 2 different "general" actions.

**Effort levels:** In our case it was clear that taking good care of the car would require a higher effort level from our part (both economically and in terms of simple effort) and that taking bad care of it would basically require no effort from our part.

**Payoffs:** I honestly don't remember the exact details of the contract that was offered to us, but let's say that the contract said the following: If at the end the lender (Principal) after examining the car considers that the car is in "good condition" we will have to pay a rent of \$A, and if the lender (Principal) considers that the car was returned in "bad condition" we would then need to pay \$B for rent, plus any additional money needed to repair any damages. Where  $A < B$ .

Considering linear functions for our payoffs, our payoffs would then be:

If outcome A happens:  $-\$A - e(\text{effort})$

If outcome B happens:  $-\$B$

**Reservation utility:** The rent that we would need to pay if we rented the car from someone else.

**Participation constraint:** The expected payoff for taking action "take good care of the car" is lower (we need to pay less money) than our reservation utility (rent that we would need to pay if we rented the car from someone else).

**Incentive constraint:** The expected payoff for taking action "taking good care of the car" is lower (we need to pay less money) than the expected payoff "take bad care of the car".

**Final comments:** This experience clearly resembles an example of principal-agent problem because the principal gives us the car and charges us a rent. Although he can't observe the actions that we take throughout the trip, he can clearly observe the final outcome once we return the car to him.

There is a **moral hazard** involved in this case because if the lender charges us a fixed rent no matter what happens, he can't observe our actions and he can't trust that we

will take the actions that will most probably lead to keeping the car in good condition (the best outcome for him). In fact, since it requires a lot less effort for us to “not take care of the car” this is what we would probably end up doing. Furthermore, if at the end we return the car in bad condition, we can always argue that we did all we could and that we took good care of it but still the car broke down, and that it is the car’s fault.

In order to avoid this conflict, it is in the best interest for the principal (lender) to give us an incentive to take good care of the car such that the probability of returning the car in good condition considerably increases. The way to give us that incentive is to offer a contract based on the observed outcomes where he offers us a lower rent for the desirable outcome and even punishes us for the undesirable outcome (if we need to pay extra money to repair any damage). This way while we can’t 100% assure that the car will be returned in good condition, we certainly have the motivation to do the necessary actions that will considerably increase the probability that this outcome will happen. In fact, this is exactly what we ended up doing. We took good care of the car, the car performed well, was returned in good condition and we paid a low rent (lower than our reservation utility).

7. Situation: Implementation of a new reporting application package.

Principal: Implementation team.

Agent: District Managers, Sales Manager, Account Managers and Additional personnel.

During the second half of 2001, I was in charge of the implementation that would change the reporting applications and its current processes. This new application would allow users to have access to business data that they did not have in the past and at the same time improve the automation and delivery of the existing reports and data.

The problem: The users were not interested in obtaining the data from the new tool nor did they want to manipulate the data. The users wanted to receive the data via email and formatted the way they wanted (this practice only increased the \_\_\_? And lead time for all the data requests).

Participation Constraint: New system report/data access and data manipulation <is better than> no system and no data.

Incentive constraints: New system (report/data access) and data manipulation <is better than> existing system (reporting/data).

Some of the items that helped during the implementation:

- ❑ Open communication
- ❑ Improved information access
- ❑ Improved development lead times
- ❑ Decreased delivery failures
- ❑ Training/Support

Motives for the change:

Principal: High reporting lead times  
Limited data access  
High # of similar reports

Agent: Unfamiliar with data  
Unwilling to change  
Not interested in working with the data (formatting/analysis, etc.)

8. In my undergraduate years, I have been engaged as a private teacher of a high school student in teaching math. Usually, my salary was paid as a fixed one, which was contracted at the beginning. However, I remember that one guardian of a student proposed me an uncommon salary contract. She, the guardian, suggested that she would give a bonus if the student could have improvements in a certain level. Even though it sounded quite weird, comparing with the common contract, it actually motivated me to do my best in teaching. In general, the basic salary was given monthly in the market, and usually the guardian could fire the private teacher if she was not satisfied with the teachers' effort level. However, I could get the promised additional salary with both parties remaining happy.

In the above true story, the situation could be modeled as a principal-agent problem like the following:

- **The principal:** the guardian of the high school student
- **The agent:** myself
- **Possible actions:** working hard, or not
- **Outcomes:** improvement of the student in a certain level, or not
- **The contract & payoffs:** basic salary with no improvement, basic salary and bonus with improvement

This situation falls into the principal-agent framework just like the Revenue Sharing Contract.

9. Work experience at a high-tech company.

I was the agent and employer was the principal. My contract involved stock options that would increase in value if company performed well. I could choose the following actions: hard work or lazy work. The outcomes would then be inc value in stock price, and/or reduced value in stock price. The payoffs for the company, assuming I worked hard would be better rev and thus better revenue. There is a reduced probability that even if lazy work were performed, rev would still increase. My payoffs are more money from inc stock option value.

10. Situation which could be modeled as a principal-agent problem: Principal – myself, Agent – owner of a small automotive repair shop.

#### The Story

What happened: I developed a good working relationship with the owner of a small automotive repair shop. He took complete care of my car for a 10-year period.

When: The time frame for the relationship was 1990-2000.

Where: Dallas, Texas

How did people behave: The agent always tried to save me money on car repairs and maintenance, while keeping my car in excellent shape. The principal (me) was very appreciative and continued to utilize his services, since I know relatively little about cars. The agent's most impressive characteristics were honesty and competence.

Possible Actions and Outcomes: The agent could have been dishonest as many car service shops are. At least, they are very willing to charge for and provide services that are premature. The outcome for this action would terminate the relationship. Another possible action for the agent would be asking for a high wage, resulting from a high

reservation utility. The outcome for this action could result in the principal finding another agent.

Why their situation falls into the principal-agent framework: First, the agent is representing the principal in the maintenance of his car, something the principal knows nothing about. Second, the agents' participant constraint has to be satisfied through sufficient wages. Third, the incentive constraint has to be satisfied by the principals' continuing to use the agents' services. If the principal doesn't continue to use the agents' services, the agent has less incentive to be honest.

Potential Conflicts in principals' and agents' motives: Principal is interested in minimizing maintenance visits and reducing their cost. Agent is interested in the reverse or opposite. If the principal minimizes the visits too greatly, the agent does not receive a fair return for his honesty and helpful consultation. If the principal tries to minimize the cost too greatly, the agents' revenue utility may not be satisfied.

The principal is also interested in competent service and advice, delivered in a cost effective manner. Without these results, the principals' objective function is not maximized.

11. Recent situation: I purchased a new car two weeks ago.

What happened: Wife and I came across an advertisement in the AJC that essentially offered a new Dodge Ram 1500 for a very low price.

When: Noticed the ad on a Saturday, purchased vehicle on Monday.

Where: Palmer Dodge in Alpharetta.

How did people behave: Dealership salesman (over the phone) acted such that the dealer's offer was "too good to pass up" and noted that advertised price was actually a loss for the dealership, so he wanted to investigate the ad. Turned out that price applied to actual vehicles listed in the ad only, and so basically amounted to "bait" to get people into the dealership.

Principal: Dealer

Agent: Me → Reservation Utility: price advertised in newspaper

Possible actions/outcomes:

- accept newspaper offer with net loss to dealer
- accept "other" offer for "better" truck with net gain to dealer
- reject offer and go to another dealership

Went to dealer and the advertised truck had been sold (mysteriously, since we called to check) the night before. So, in order to keep us at the dealership, salesman made "other" offer for similar truck.

Incentive schemes: Similar truck with more luxuries (i.e., leather upgrade, tow package, etc.) for slightly higher price. For me, my participation (initially) was conditioned on the price being equal to that advertised (after all, that is why I went to that dealership).

Since the advertised truck was no longer available, my participation was now conditioned on being no more than \$800 more than my original U. This was because I knew any truck I looked at would now have more luxuries.

Motive conflicts: Dealer wanted to make money, I wanted to pay as little as possible. In the end, I walked out with a new truck for my reservation utility (\$25,800) and the dealer managed to sell me another truck for a small gain (turns out that I paid roughly \$100 over invoice).

### How did I affect this result?

- 1) Stuck to my reservation utility, and when dealer tried to wiggle in this or that for more money (the “meet me halfway” gimmick) I simply told him that a new truck was not a necessity and so I was walking out. More important for him to go with original offer and get inventory off the lot than haggle over a few dollars.
- 2) Have one tough mama for a wife who strong-armed the dealer!!

12. My wife and I have just recently agreed to sell out house in North Carolina. In doing so, we feel like we have been a part of a principal-agent problem. In our situation, we believe that we are the principals, and our agent has been the agent. We decided to sell the house last summer but needed an agent since we had moved away and would not be able to oversee the process. We hired the agent based on a recommendation of a co-worker. We knew how much our payoff balance was, and were all too familiar with our monthly mortgage payments. We also knew that the house was in good condition, since we had just replaced the carpet and repainted the entire interior. Based on those facts, we felt that if the house sold for \$89,000, we could break even on the costs. Hopefully, we could do better, but breaking even was our goal.

Our agent was obviously very familiar with the area and knew the market, so could recommend sales prices to us. She also had toured the house and therefore knew the condition of the property. Given her knowledge, she recommended and we agreed, upon setting a sales price of \$94,000; the contract also earned her 6% sales price as commission. However, just as in a principal-agent game, since we were not in the same city, we were unable to see how much effort she put into the sale.

Unfortunately, I did not take this class until now, so we “trusted” that the agent would work hard for us. However, that fact highlights the primary conflict between the agent and us; the contract with our agent was fixed, regardless of effort. Possibly as a result, the house has been on the market for 8 months without an offer. Further, we lowered the sales price in December. Perhaps had we lowered it earlier, we would have sold it more quickly. As it stands, we have just received and accepted an offer on the house, and we will come close to breaking even. We count ourselves lucky to have emerged, but we are skeptical about the principal-agent contract we entered. Specifically, we should probably have conditioned our agents’ payoff on selling the house within a particular time frame. Perhaps that would have induced her to work harder or recommend lowering the price sooner. However, as her contract was written, she would collect her 6% commission whether the house sold in September or April.

13. In the Army, the manager of the convenience store and coffee shop in the military camp is an officer and tries to find someone among the privates (soldiers doing their military service) to work for him. Because soldiers are not paid their payoff for working in the convenience store is number of days permit out of the military camp. The manager’s payoff is the profits from the convenience store that the agent delivers at the end of each month. Because officers do not stay in the military camp after 3pm (unless they are on duty) they cannot observe the agent’s effort (i.e., how long after 3pm the convenience store in the military camp is open) but the principal can observe the profits at the end of the month. Moreover, there is the danger that the agent will keep some of the profits for himself and will not deliver them to the principal. Therefore, the usual

strategy followed is that the principal offers to the agent a number of days permit for sure (for example 5 days) and an additional number of days (say 10 more) proportional to the profits he will deliver to the principal. The principal however is experienced and knows more or less how much the convenience store makes each month. In case the agent does not make any profit, he is punished and may go to military court. This way the agent is forced to exert as much effort as possible to make a profit so that he can get more days permit.

14. I worked for Duke Power, the regulated electric utility owned by Duke Energy, in 1999 and 2002. In this industry, we can think of the government as the principal and the utility company as the agent. The government in effect sets “wages” in the form of imposing limits on profits – if profits, as reported in earnings statements, are “too high,” the utility is ordered to cut rates. Thus, the principal structures things so that the agent’s profit is constant.

What can Duke Power do to increase its profits? Working hard to become more efficient will, if visibly successful, only cause the government to take back the extra money in the form of a rate decrease. Thus there is a strong incentive for Duke to underreport its earnings and overstate its costs. Shortly after I left, the government accused Duke Power of doing just this; the case was settled for \$25 million.

15. When I was in a grad school lab about 5 years ago, the supervisor (professor) of the lab offered the students in the lab tuition waiver as basis, but the stipend is paid based on the projects’ outcome on which each student worked. Sometimes several students were involved in one project an obviously not everyone in the project put his/her best effort. So the outcome of project is not only based on individual’s effort level, but based on other people’s effort levels.

Principal: lab supervisor

Agents: students involved on a project

Actions: high/small/no effort

Outcomes: excellent/good/so-so/bad

Contract: Stipend is based on the project outcome

16. In the summer of 2001, I completed my internship in a safety footwear factory in Ankara, Turkey. The company was both producing safety footwear and military footwear. It had some regular customers, so producing regularly for them. However, these customers constitute a small percentage in total number of customers. The firm works mostly on contract basis. When they get win the contract, they produce the required items and deliver them. So it is to their best interest to manage the capacity optimally.

Since the products are only from contracts, they do not have exact production times for each model, they just have estimations. For example, if 10,000 footwear to be produced, they estimate that it will take a week with 75% probability and will take a week and a half with 25%. Moreover, they know that this is mainly manual work and therefore if the workers show high effort they can finish the job in a week. So the problem becomes if the workers show high effort the job will take a week, with a high probability, if the workers don’t work hard, it will take definitely a week and a half or

more. And to be able to be ready for more contracts, they want to finish jobs on hand as soon as possible.

In this environment the factory managers are principals and workers are the agents. Due to the type of the job it is quite difficult to observe the effort level of the workers. When I was in the factory, they were working on an incentive scheme to make the workers work harder.

The workers were getting minimal wages, so there were ? indifferent between working in the factory and somewhere else. Moreover, the working conditions were not very good, so they do not want to work harder. On the other hand, management was planning to win new contracts so they needed the capacity for the incoming work.

As a result, they decided to set up production level goals. When the daily production is above some level, workers get bonuses. I do not know how they set the production levels and bonus levels but it seemed like it was working during the time I was there.