

# The Rotten Mango: The Effect of Corruption on International Development Projects

## Part 1: Building a System Dynamics Basis for Examining Corruption

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### Abstract

*Corruption diverts perhaps 30 percent from billions of dollars spent annually for international development loans. Importantly, this illegitimate cash flow becomes the primary reason why funds are requested. Desire to maintain this flow alters project planning, design and implementation. Bureaucratic and personal work characteristics become imbedded in, and reinforce, these corrupt systems.*

*Corruption literature provides a rich source of data and theory which can serve as a foundation for SD models of corruption including mathematical sub-models and typologies of corrupt systems, narratives of instances of corruption, and proposed remedies. An overall paradigm, allowing us to consider, in a holistic way, the many sub-systems of corruption has not been developed.*

*This literature provided a basis for SD model building. Additional experiences in Indonesia maintained model realism. One SD corruption overview is based on the oft cited idea that 'amount of corruption' is part of reinforcing loops linked to 'amount of bureaucratic red tape.' In this view, corruption is imbedded in positive feedback loops also linking it to lowered economic openness, a weak legal system, and excessive economic rents available. Stabilizing influences are provided by negative feedback loops in which increasing corruption provides pressures to improve the legal system and causes, through mismanagement, decreased economic rents. Other more detailed SD views include factors that affect the likelihood that a bribe is paid and the psycho-social aspects of corruption within the work environment. Taken together these indicate that SD modeling has considerable potential for elucidating corrupt systems and cures.*

### INTRODUCTION

Corruption is widespread and has particularly serious impacts in developing countries where badly needed development funds are often in short supply. Projects funded by international development banks seem to provide easy targets for corruption perhaps because these funds are perceived as coming "from outside" and are subject to relatively little external monitoring.

Over the years numerous studies of corruption have been carried out. These have focussed on specific aspects such as: economic impacts, legal solutions, social implications, effects on national development, and relation to economic policy. Theoretical examinations of corruption have emphasized econometric modeling, game theory, and similar mathematical approaches.

These approaches, to be analytically tractable, have addressed only particular subsets of an entire corrupt system.

System dynamics should provide an ideal approach for examining corruption dynamics because it avoids the necessity of setting up models in a purely mathematical manner. Initial models can be presented in an understandable format for discussion with those who will have valuable input into subsequent model alteration leading to a better understanding of corruption dynamics.

The objective of this paper is to develop initial system dynamics models of corruption, so that these can be modified in cooperation with knowledgeable persons. Modified models can then be used to identify possible approaches to reform corrupt systems. Ultimately such models might permit examination of areas where corrupt systems are most sensitive to intervention. At this stage, emphasis will be on factors affecting corruption related to internationally funded development projects, using literature as a source of information. These views are tempered by experiences and literature specific to Indonesia. Indonesia is listed as one of the most corrupt countries in the world<sup>2</sup>, but it is now going through a transition period that may allow reform to be more easily instituted. Thus, one is hopeful that an improved framework of understanding corruption coupled with existing reform movements may provide a window of opportunity for real reform of corruption to occur. It is hoped that this modeling initiative can be a part of that process.

The ultimate goal of this work is to assist in the development of a logical theoretical framework which can be used to examine corruption dynamics. While it is difficult to judge the ultimate effect such a modest activity can have on actual reform of corrupt systems, without a firm logical framework for reform, reform itself seems unlikely.

## **BACKGROUND**

Reports concerning corruption could fill a small library. The subject can be sub-divided into various categories: effects of corruption, comprehensive summaries, causes, methods of control, practice in specific countries, need for reform, reform methods. Over the decades several books have been written on the subject (e.g. Elliot 1997, Klitgaard 1988, Rose-Ackerman 1978, 1999). Apparently there are over 700 books about corruption currently available.

Academic disciplines examine corruption from many perspectives: economics, sociology, political science, law, development studies, and area studies. However, few approaches attempt to look at the problem in a holistic way. In fact, in the introduction to their volume on corruption Harris-White and White (1996) refer to a "...bewildering array of alternative explanations, typologies and remedies ..." that have been used to investigate corruption. They further state that "...while this work is quantitatively impressive it has not culminated in a paradigm of analysis which is useful...".

The most obvious consequence of corruption with respect to internationally funded development projects is the decreased availability of funds for legitimate project work and consequent increased costs to accomplish stated project goals, if they are in fact ever accomplished. That is, as corruption becomes more prevalent, legitimate project needs compete with illegitimate uses of project funds.

Sadly, theft of money and decreased value of a particular project are only minor effects of a corrupt system. As corruption becomes routine many other factors conspire to make it complex and self re-enforcing. A culture of corruption develops. Individuals who would otherwise be honest are influenced by corrupt individuals both directly and indirectly. Favoritism by a corrupt boss toward employees likely to provide payments influences these employees and forces them to participate in corrupt practices. People who do not participate do not receive promotions and pay raises.

Individual benefits which corruption yields, leads to the hoarding of key project management positions by relatively few individuals. Loyalty rather than qualification determines the assignment of other staff to project activities. This will affect many related, concurrent projects as key corrupt individuals and their underlings acquire additional project assignments.

In order to best participate in a corrupt system a person needs to be employed in a management position. Thus excessively complex management arrangements evolve. Research and teaching jobs, for example, receive even less attention than usual. Senior personnel tend to want to hold onto their positions because retirement benefits are low compared to those from corruption.

Promotion and salary increases depend not so much on work performance but also on payoffs and loyalty to corrupt officials. Honest employees, who would have difficulty finding alternate employment, must consider effects on their family. If they wish to avoid serious financial difficulties they must go along with a corrupt system. The integrity and advancement of honest employees is seriously compromised.

A corrupt system deflates the value of work performed in project planning because subsequent planning decisions do not depend on a careful assessment of needs and goals, but rather on the need to maintain cash flow. Thus there is a continuing motivation to design new and large projects. A corrupt system can actually result in an increased flow of money from the development banks, and such a flow appears to be consistent with the banks' goal of providing funds for development.

It is possible that some corrupt practices result from a desire to help employees, particularly in systems where salaries are very low and options for additional income limited. In fact, if legitimate project funds are diverted at higher administrative levels, then additional corrupt practices at lower levels may be the only source of salary increases and bonuses.

Once corrupt practices are initiated it is presumably difficult to extract oneself from them. Co-conspirators will have created, and will keep, a shared secret.<sup>3</sup>

### **INFORMATION SOURCES FOR MODEL BUILDING**

Comprehensive reviews of studies of corruption and theories endeavoring to explain it serve as a starting point for model building. The background papers by Rose-Ackerman (1996), Tanzi (1998) and Goudie and Stasavage (1997) include concise verbal descriptions of models and theories used to analyze and explain various aspects of corruption and means of control. Also of interest is a World Bank report (1997) which details initiatives to assist countries to combat corruption. For a more pessimistic view of corruption one can consult Charap and Harm (1999). These reviews plus detailed verbal descriptions of corruption (e.g. Kahn 1996), as well as consideration of bribe giving (Vogl 1998, Lambsdorff 1997), provide the basis for

mental models of corruption. These mental models then can be used to develop a basic system dynamics model. That is, detailed accounts about specific aspects of corruption provide insights into overall model structure and provide starting points for sub-model development.

Various mathematical and econometric theoretical treatments of specific aspects of corrupt behavior may also provide suggestions for specifying components in a SD model. Examples of such literature are Andvig (1991), Andvig and Moene (1990), Bac (1996), Cadot (1987), Dawid and Feichtinger (1996), Feichtinger and Wirl (1994), Lambert-Mogiliansky (1995), Rijckeghem and Weder (1997) and Rinaldi et al (1998).

## **INITIAL MODEL IDEAS**

### **Purpose**

Models developed will seek to explain causes of corruption and reasons for its persistence eventually with emphasis on externally funded development projects. As indicated above, the overall goal is to assist in the development of a logical theoretical framework which can be used to examine corruption dynamics, particularly in order to elucidate actions which might decrease corruption. Models should be able to produce behavior similar to that found in corrupt systems.

The typical behavior pattern of a corrupt system might have the following characteristics. Amount of corruption will be relatively stable and difficult to reduce. Corruption will increase, and might stabilize at some relatively high level. Anti-corruption measures will be ineffective or will have only temporary results. As corruption rises bureaucratic red tape also increases, and economic openness and strength of the legal system will decline.

Within development projects under corrupt systems, we might see the following patterns. The proportion of funds used efficiently will decrease over time. Project benefits per unit cost will decrease, reaching a low but stable level. Increasing inefficiency may be detectable in project delays, failure to meet goals, difficulties in obtaining the release of funds at various levels, and in increasing complexity of project design and administration. Requests for development loans will gradually increase above normal expectations with numerous requests for follow-up projects. Increasingly project funds will be managed via non-transparent methods. For example: sub-contracting, and lump-sum or flat rate billing, rather than at-cost billing.

### **Model Design and Structure**

Eventually a completed suite of corruption models will probably take the form of nested models. One model might describe the overall system, with sub-models providing additional detail. The sub-models will also be dependent on each other. In the following, as yet incomplete, description this idea is presented as follows: The *Red Tape* model presents a macroeconomic overview of corruption. The *Bribe Likelihood* model looks in more detail at factors affecting bribe givers and takers, while the *Boss - Employee Relationship* model looks at questions of interdependencies within the bribe taking bureaucracy. A fourth, as yet unfinished, *Power and Corruption* model looks at the consolidation of power and exploitation of bureaucratic corruption by key personnel and their cronies.

**THE RED TAPE MODEL**

***Red Tape Loop Structure***

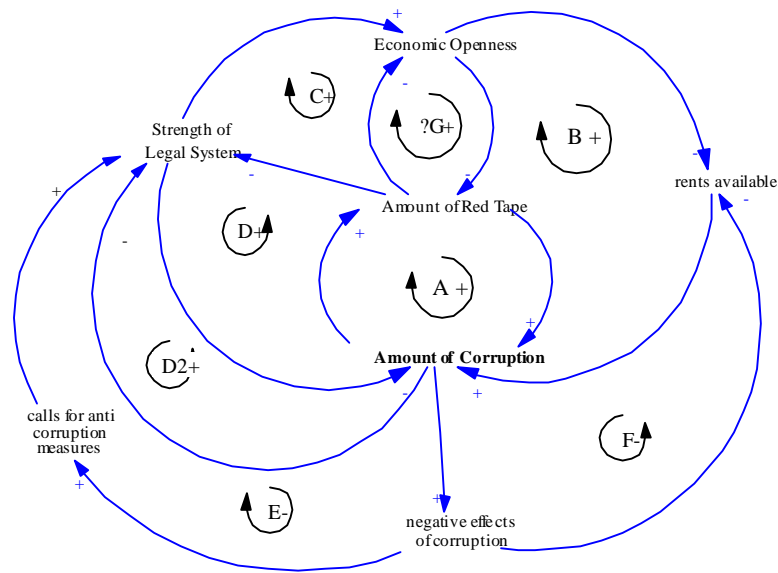
One initial overall view of corruption links corruption to general economic openness and bureaucratic complexity. In this view, corruption increases, and is increased, by the amount of red tape.<sup>4</sup> That is, the amount of bureaucratic confusion paves the way for individuals or businesses to pay bribes to officials who, as they gain more control, can create more bureaucratic roadblocks requiring payment. This is indicated in reinforcing loop A (Figure 1). In addition the increases in red tape cause lowered economic openness which increases excessive rents available. This in turn encourages more corruption (reinforcing loop B). As the bureaucratic situation becomes more confused with conflicting rules and regulations, the strength of legal institutions is weakened (loop D). This weakness encourages more corruption which directly effects the legal system as more officials become corrupt and also decreases economic openness (reinforcing loops C and D2).

As corruption increases the negative effects of corruption are felt. Rents available through illegal activities start to drop through mismanagement of corrupt concessions (balancing loop F). Negative effects of corruption also increase calls for anti-corruption measures which causes a strengthening of the legal system (balancing loop E). We may also believe that red tape can be dissipated by increasing economic openness (reinforcing loop G).

Although this approach provides an overall understanding of a corrupt system, it does not address factors influencing human behavior within such a system. Factors affecting behavior include such influences as economic needs and desires, salary level, corrupt colleagues and influence of ones boss.

***Red Tape Model Structure***

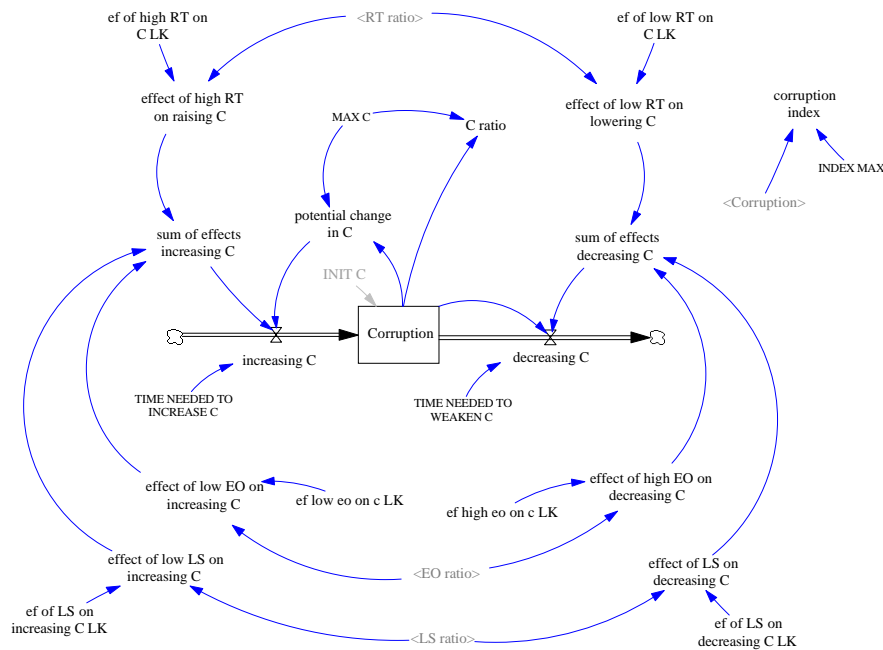
The Red Tape model consists of four stocks: Corruption, Red Tape, Economic Openness, and Strength of the Legal System. Each of



**Figure 1.** Causal loops describing the Red Tape Model of a corrupt system. In the form presented here this model has four positive and two negative feedback loops.

these stocks is structured so as to have a range from zero to 10. A value of 10 is the best possible for the stocks Economic Openness and Strength of the Legal System, while 0 is the worst possible value for the stocks Red Tape and Corruption.

Increases to each stock are fractional values of the difference between current stock amount and the maximum possible. Decreases are fractional values of the existing stock. The portion of the model structure for the stock Corruption is indicated in Figure 2.



**Figure 2.** A portion of the Red Tape Model illustrating the effects on the stock "Corruption". This stock is affected by three other stocks via the ratios indicated: RT= red tape, EO= economic openness, LS= strength of legal system. The remainder of the structure is presented in Appendix 1.

Also indicated in this view is the corruption index, modeled to coincide approximately with the corruption index of Transparency International<sup>5</sup>, which ranges from zero for "most corrupt" to ten for least corrupt.

The similar model structures for the three other stocks are presented in Appendix 1. Also presented in that appendix are figures illustrating the 19 hypothesized lookup functions. The general direction of these functions is based on corruption literature, but the exact form of each is necessarily very speculative. Time constants for the flows are from one to three years.

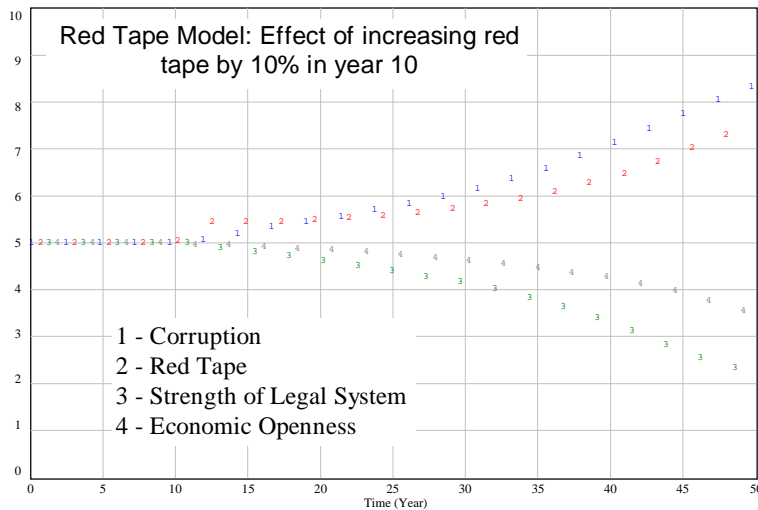
Some model components might be added later. For example, it is likely that the legal system not only affects corruption directly by removing corrupt persons, but also operates via a variable "fear of being detected and punished". This fear could change more rapidly than the legal system itself. This might happen, for example, via the prosecution of corrupt high level bureaucrats where convictions would have high public visibility (e.g. see Klitgaard 1998).

**Red Tape Model "Results"**

The Red Tape model is set up to be in equilibrium to describe a moderately corrupt country where the corruption level, and all other stocks are 5. The following comments assume that the lookup functions are preliminary but reasonable representations of reality.

As initialized the model is in unstable equilibrium and stocks will approach their highest or lowest value if one or more of the stocks is pushed up or down, although the rapidity of that change is dependent on extent of the push. In other words, when pushed off equilibrium the model approaches either a very corrupt system or a very clean system (Figure 3).

The fact that the red tape model is unstable equilibrium at intermediate corruption values may



seem problematical. A system capable of stability at intermediate values might seem logical. However, at some point (though not necessarily at corruption = 5) corruption in the real world does seem to "take on a life of its own" and becomes self reinforcing. Literature on the subject supports this idea and, in fact, this behavior embodies the very problem we are investigating.<sup>6</sup>

Figure 3. Illustration of the unstable equilibrium of the Red Tape model when initialized with all stocks at 5. Note that after a 10% increase red tape remains relatively constant for 10 years but gradually starts to rise.

If initialized in a corrupt mode (by initializing the stocks as Corruption =7, Red Tape =7, Strength of Legal System =3, Economic Openness =3) the model is difficult to push into a non-corrupt mode. This is illustrated in Figure 4, where the stocks are adjusted by a reform program which cuts red tape by 50% and improves the legal system by over 140% over a 10 year period. After the reform activities are terminated the system rebounds to the corrupt mode. An even stronger reform program (Figure 5) accomplishes the task of pushing the system into a region where the clean mode will dominate, but the system will still take many years to be rid of most corruption.

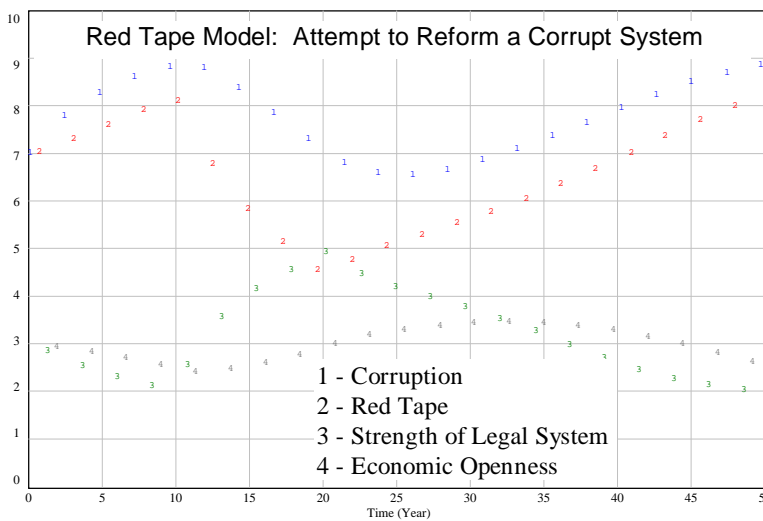
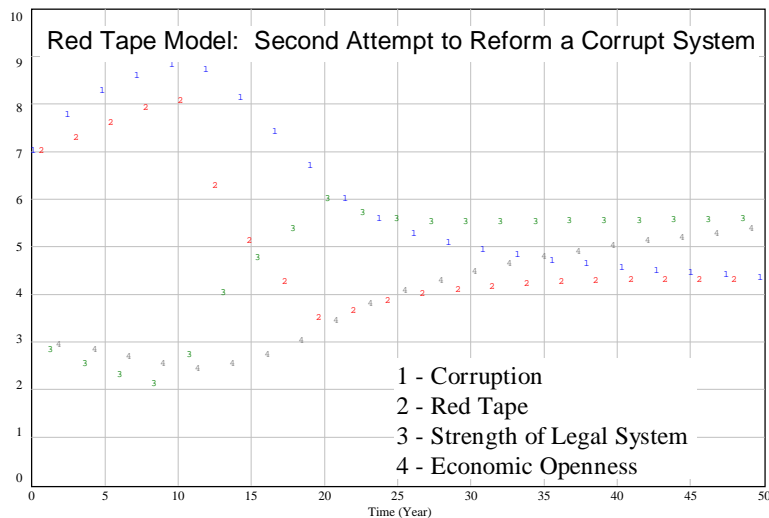


Figure 4. An illustration, using the Red Tape model, of an attempt to reform a fairly corrupt country with a two pronged 10 year crash program of lowering red tape and improving the legal system. Lingering corruption and remaining lack of economic openness tend to pull the system back into the fully corrupt mode. Improvements were made at an annual rate of about 10% of the remaining possible improvement during the period from year 10 to year 20.

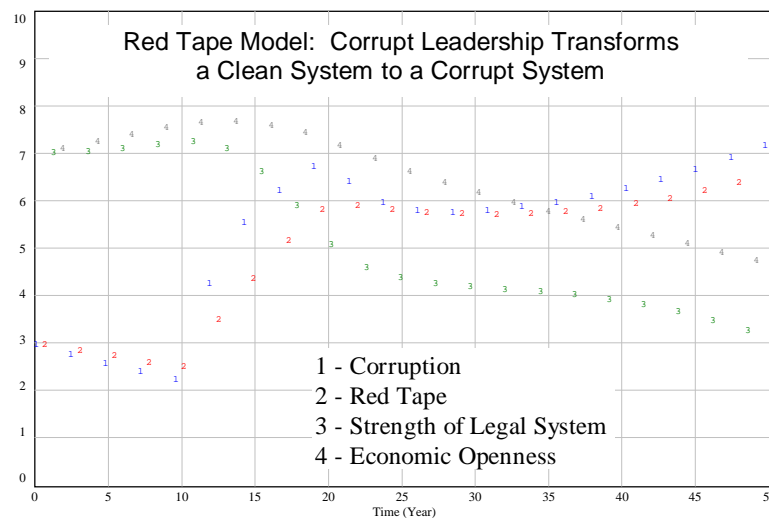
The model exhibits a similar but reverse behavior when started in a clean mode with

the initial values of the stocks reversed (Corruption and Red Tape at 3 and Strength of Legal System and Economic Openness at 7). This represents a country gradually moving from a moderately clean to a clean status.



**Figure 5.** If sufficient change is provided to reform red tape and the legal system, then eventually the system will be changed enough to continue to move into clean mode without additional special effort. In this case it will take 50 years beyond that shown here before the system would be considered clean. Improvements here were made at an annual rate of about 13% of the remaining possible improvement during the period from year 10 to year 20.

Figure 6 might represent this initial clean situation interrupted by the takeover by a corrupt leader for 10 years. During this period we can envision that corruption increased directly and also that additional red tape is deliberately created (both at the annual rate of 10% of available increase). Here the formerly clean system is pushed across into the corrupt mode and corruption and its associated characteristics continue to increase after the corrupt individual is removed from power.

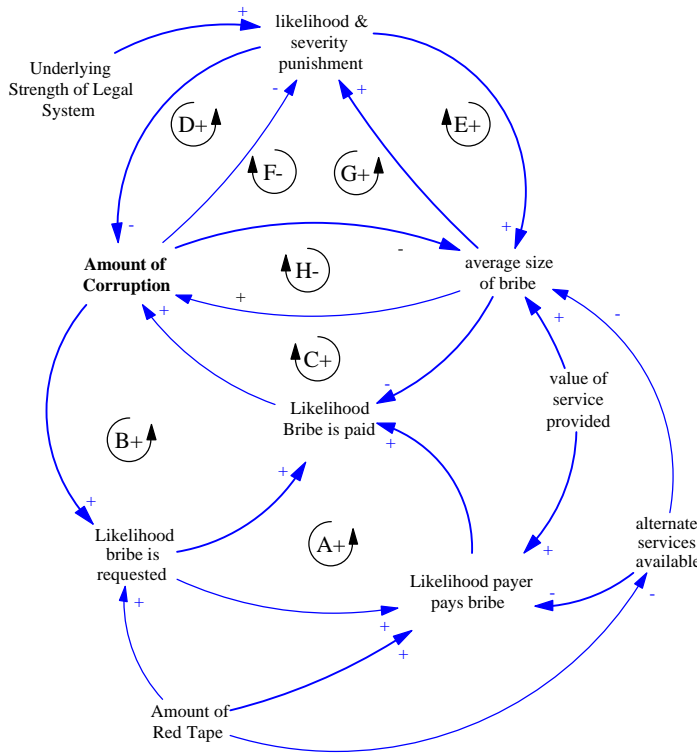


**Figure 6.** A system in an initially clean mode can be pushed into a corrupt mode by sufficiently large increases in corruption and red tape as shown in this hypothetical example where a corrupt leader is in power for 10 years.



**BRIBE LIKELIHOOD MODEL**

Another view of corruption is based on factors affecting the likelihood that bribes will be paid. This is linked to the amount of corruption already existing, the availability of other sources of the same service being sought, the value of the service provided, the effectiveness of anti corruption measures (represented here by likelihood of detection and severity of punishment) and the amount of bribe money requested. The causal loop diagram in Figure 7 represents this viewpoint.



**Figure 7.** A view of corruption which emphasizes factors affecting the likelihood that bribes are paid.

Here, the likelihood that a bribe is paid is dependent on the likelihood that a bribe is requested, the likelihood that the payer thinks a bribe should be paid and the size of the bribe.

**Bribe Likelihood Loop Structure**

Three positive feedback loops reinforce bribe likelihood. These are all linked to the likelihood that officials are corrupt which here is represented by amount of corruption. In reinforcing loop A an increased amount of corruption increases the likelihood that a bribe is requested thus increasing the likelihood that the payer thinks a bribe should be paid which increases the probability that a bribe is paid further increasing the amount of corruption. Loop B reinforces the likelihood that the bribe is paid in a more direct manner. Thirdly, as likelihood of bribe payment increases the amount of corruption, the average size of a bribe decreases which increases the likelihood that a bribe is paid (Loop C).

Loops D through G all are related to the effect of the level of punishment on corruption. These effects result from the effect of severity of punishment on both the amount of corruption and on the average size of bribe paid. If the amount of corruption is high, the punishment system is undermined and punishments become less severe. Lowered likelihood of punishment leads in turn to more corruption (loop D).

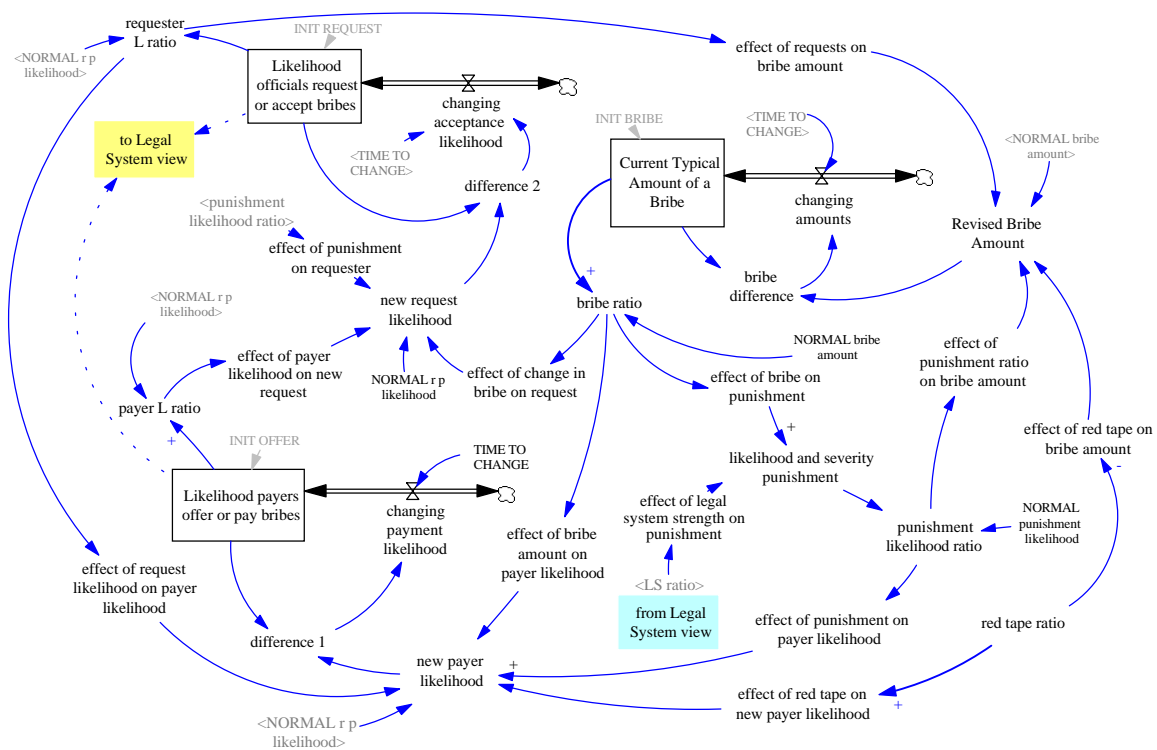
Interestingly, increasing severity of punishment also increases the average size of the bribe, since accepting a bribe becomes more risky. The larger bribes subsequently cause an increased risk and severity of punishment (reinforcing loop E). Also, increases in the average size of a bribe will increase the likelihood of punishment which decreases the amount of corruption. This change will increase the average size of a bribe further (reinforcing loop G).

Balancing Loop F operates in the opposite manner. As probability of punishment increases, the size of a bribe also increases. This causes more officials to become corrupt since they are tempted by the higher payments. This increased corruption then lowers the likelihood of detection and punishment. This loop reflects the idea that corruption creates an interdependence and trust among corrupt officials which lowers the probability of discovery (Rose-Ackerman 1999 p.98). Loop H indicates the same idea in a more direct manner.

**Bribe Likelihood Model Structure**

The structure of the bribe likelihood model contains four stocks: Likelihood Officials Request / Accept Bribes, Likelihood Payers Offer or Pay Bribes, Current Typical Amount of a Bribe, and Strength of Legal System. Strength of Legal System is structured in the same way it is structured in the Red Tape Model (Appendix 1). The other three stocks are structured as follows: a new value is calculated for each stock based on a normal value for the stock and the current value of factors affecting it. This new stock value is compared to the current value and the difference is absorbed into the stock over a period of one year. As modeled herein Red Tape is represented by the constant: red tape ratio, but in future versions red tape will be included as a stock.

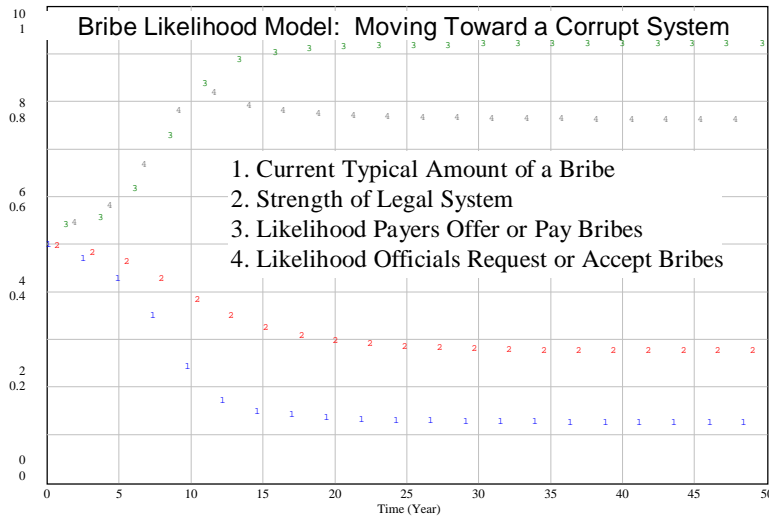
Items in the model diagram starting with "effect of..." are equal to the output of look-up functions which are not shown here. The total amount of corruption is calculated as the average of the request and payer likelihoods, which each normally range from 0 to 1, times the maximum amount of corruption (10). Thus corruption amounts in this model correspond to those in the Red Tape Model.<sup>7</sup>



**Figure 8.** Three stocks of the Bribe Likelihood Model appear in this portion of the model. The fourth, Strength of Legal System (the legal system view) is presented in Appendix 1.

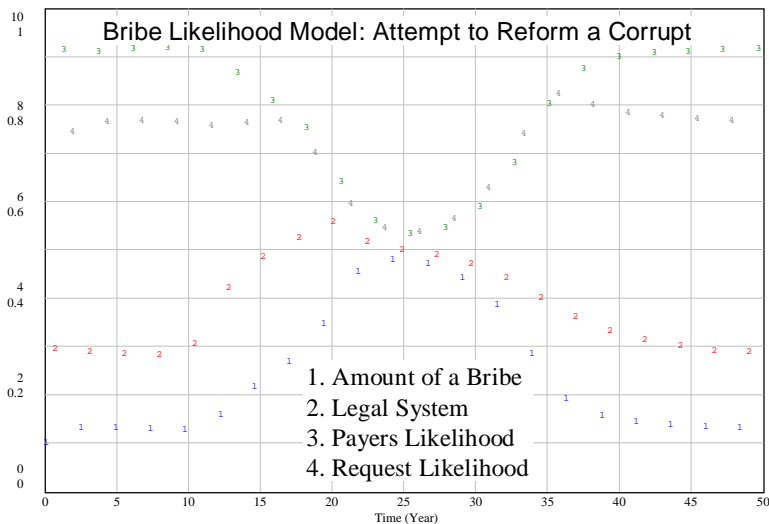
**Bribe Likelihood Model "Results"**

Like the Red Tape Model the Bribe Likelihood Model was initialized to be in equilibrium at intermediate values. These were 0.5 for both bribe likelihoods and 5.0 for the legal system strength and Current Bribe Amount. When initialized in this manner the system displays unstable equilibrium and moves toward a corrupt, or a clean, equilibrium if any stock is given a bias toward one extreme or the other.



**Figure 9.** Here the Bribe Likelihood Model is initialized with Likelihood Payers Offer or Pay Bribes slightly to the corrupt side of the starting equilibrium values.

In cases where any of the stocks is initialized toward a more corrupt situation the system moves into a corrupt equilibrium. In cases where any stock, except Strength of the Legal System, is initialized toward a cleaner system the change is considerably more gradual. If Strength of Legal System is initialized slightly toward a cleaner system (e.g. at 6 instead of at 5) then the move toward a cleaner system is more rapid.



**Figure 10.** Illustration of an attempt to reform a corrupt system by strengthening the legal system over a ten year period. The strengthening of the legal system was at a rate of 10% of the remaining possible improvement per year for 10 years.

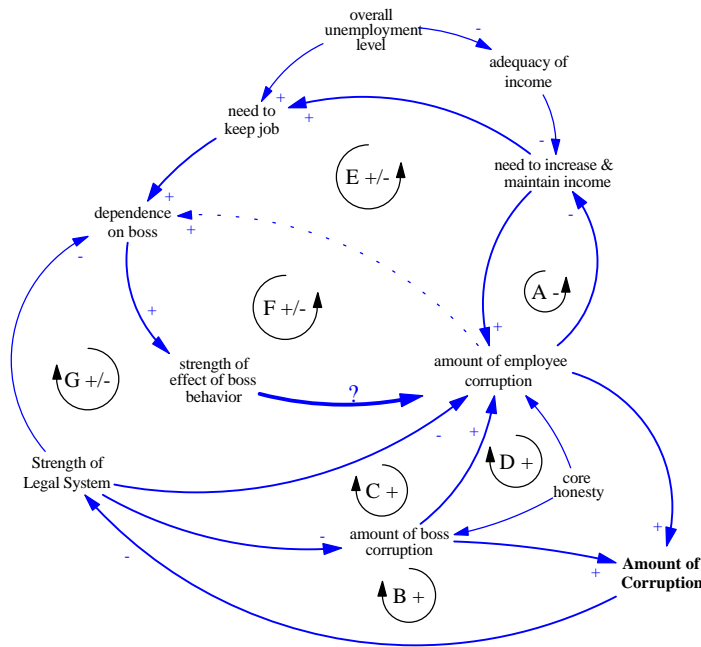
As in the Red Tape Model this model also resists change to a cleaner system. Figure 10 illustrates an attempt to change a corrupt system by strengthening the legal system over a period of ten years.

One of the areas where particular attention is needed is in the balance between the effect of a higher bribe amount on likelihood of punishment and its effect on increasing the likelihood that a bribe is requested.

**EMPLOYEE - BOSS RELATIONSHIP MODEL**

***Employee - Boss Relationship Loop Structure***

A third view of corruption emphasizes the relationship between employees and bosses within a corrupt system. An employee may be tempted into corrupt practices by a need to increase income (loop A) with the likelihood of this happening being dependent on the adequacy of the employee's current income. Also, the level of corruption among both employees and bosses affects the overall corruption level which affects the strength of any relevant legal system (e.g. including anti corruption policies with in an organization). Any weakening in this legal system, or decrease in the likelihood of being punished, will tend to increase the amount of



**Figure 11.** Loop structure describing the relation between bosses and employees within a corrupt system. The Employee - Boss Relationship Model address a portion of this structure.

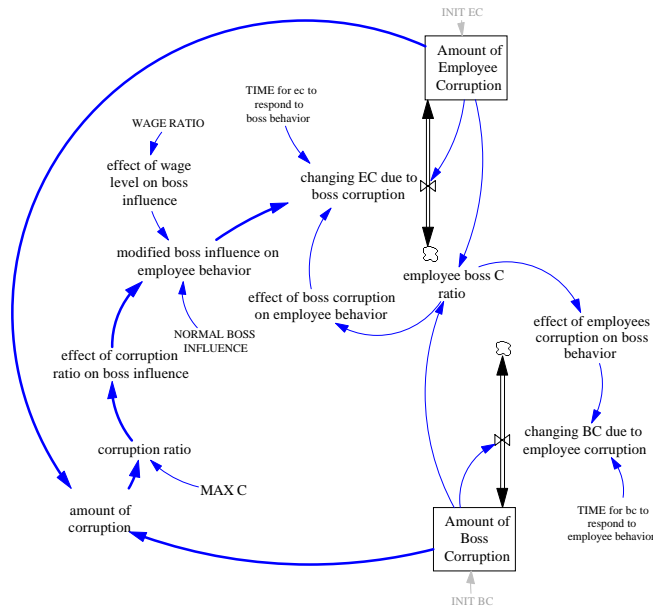
highly dependent on good relations with their bosses (loop E). In such a case bosses' behavior becomes a primary component influencing the employees' behavior. If the boss is corrupt the employee will need to support that corruption. Thus within loop E, strength of effect of boss behavior will have a counterbalancing effect on employee corruption if the boss is honest, but will encourage employee corruption if the boss is corrupt. Because loops F and G also include the strength of effect of boss behavior, these loops can also be counterbalancing (-) or reinforcing (+).

***Employee - Boss Relationship Model Structure***

I have chosen to model only a portion of the structure shown in Figure 11 since the effect of the legal system here is not significantly different than it is in the models presented above. The model structure (Figure 12) describes only the relationship between the boss and employee with the effect of wage levels added.<sup>8</sup>

employee and boss corruption (loops B and C). Importantly there is a direct influence of boss corruption on that of employees. An increase in the amount of boss corruption will increase the amount of employee corruption increasing overall corruption and decreasing legal system strength (especially within an organization) (loop D).

Employee corruption is further increased by the degree of employee dependence on a boss. This is related to the importance of an employee's need for job security. High unemployment would make finding another job difficult. If employees fear for their jobs they are



**Figure 12.** A simple version of the Boss - Employee Relationship Model. Variables starting with "effect of " are the result of lookup functions not shown here.

As modeled here Amount of Boss Corruption and Amount of Employee Corruption eventually coincide. The corruption amount at which they coincide is dependent on both the influence that the boss has on employee behavior and that which the employee has on boss behavior.

Boss corruption is affected directly by employee corrupt behavior. If employees are much more corrupt than the boss then boss corruption can increase at a rate of up to 15% over a two year period. If employees are much less corrupt than the boss, then boss corruption could decrease at a rate 20% of boss corruption over the same period.

There is a similar effect of boss corruption on employee behavior, but this effect is stronger. If boss corruption is much higher than that of the employee the effect is at a rate of 40% increase in employee corruption over a 6 month period. If the boss is much less corrupt than the employee then employee corruption can be lowered by as much as 30% over the same period of time (ignoring other effects).

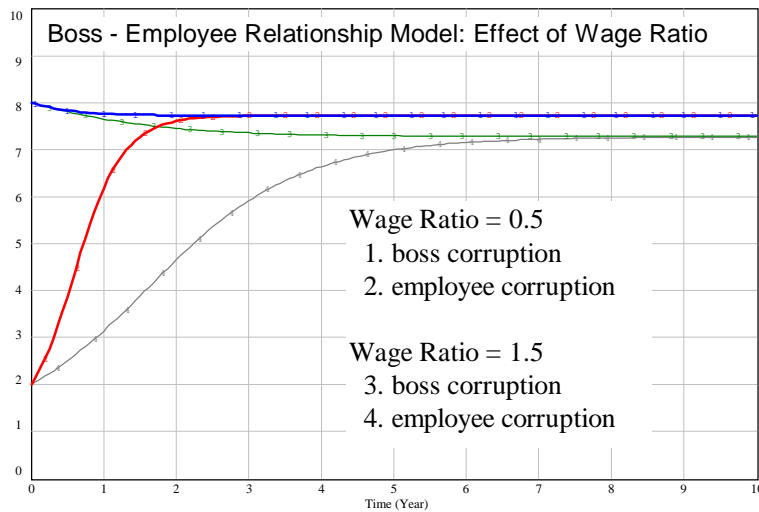
However, the strength of the effect of boss corruption on employee behavior is in turn affected by the amount of corruption and also by the current wage level. If corruption is high then the effect of a boss's behavior on employees is strengthened because the employees will have a harder time reporting or ignoring the bosses' corrupt behavior. Also, if wage levels are low then employees are likely to be more dependent on the boss and his favors. These effects can strengthen or weaken the effects described in the previous paragraph.

**Employee - Boss Relationship "Results"**

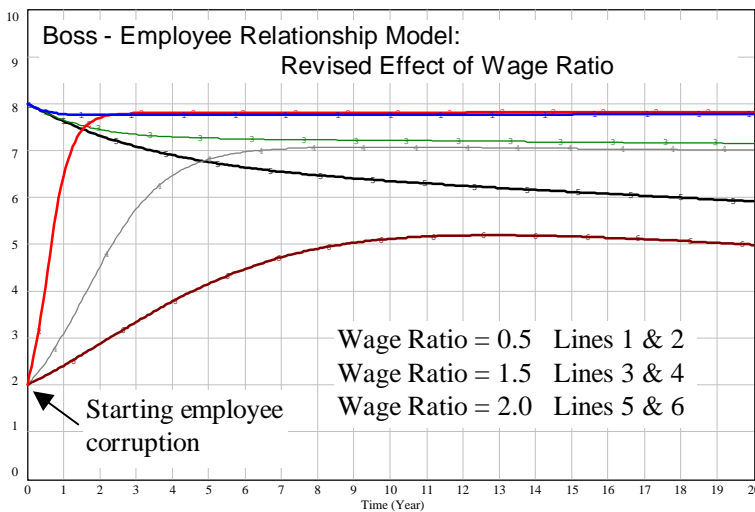
An example of these effects is shown in Figure 13 where a relatively honest employee is working with a relatively corrupt boss. Under conditions of low wage levels (wage ratio of 0.5) about 2.5 years are needed before the employee's corruption level matches that of the boss. If the wage level is 1.5 then 7 years elapse before the two corruption levels coincide.

The approach modeled assumes that the employee and boss will eventually have the same corruption level, implying that employee and boss corruption are never independent. If we wish such independence an additional inflow to, and outflow from, employee corruption will permit a more direct influence of wage level on employee corruption. With this addition the two corruption levels can remain different (Figure 14). Note that the effect of wage level on boss corruption is not considered here.

Importantly, the boss employee relationship reflects the same situation on a larger scale. If top level bureaucrats are corrupt then it is more likely that lower level bureaucrats are also corrupt. This leads us to the last of the four preliminary models: Power and Corruption.



**Figure 13.** Illustrated here are two cases of boss and employee corruption where the boss is considerably more corrupt than the employee. Lower wages force more rapid compliance to the bosses corruption level.



**Figure 14.** Illustrated here are three cases of boss and employee corruption where the boss is considerably more corrupt than the employee. In this version some independence has been provided to the employees by providing a direct effect of wage level on employee corruption via additional flows to and from the stock Employee Corruption.

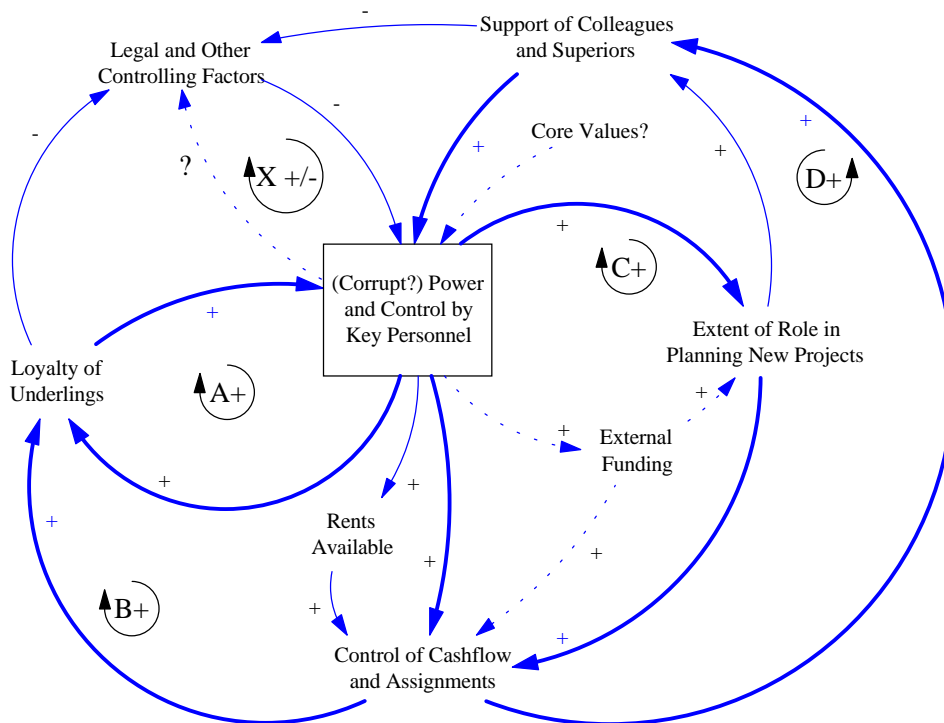
**POWER AND CORRUPTION**

One of the most important aspects of corruption is the role played by powerful, top level bureaucrats. Because their behavior, and the extent of their power, determines the level of corruption at the highest levels of government, the phenomena affecting their power and control need to be examined. Corrupt individuals with sufficient power are able to increase opportunities for cash flow including control of existing projects and the planning of new projects. This further increases their administrative power and visibility within the bureaucracy. With increased power they can appoint cronies to adjacent and supporting positions which further reinforces their power and control.

Charap and Harm (1999) discuss parallel ideas emphasizing the idea of competing teams of corrupt bureaucrats. Eventually a full Power and Corruption Model might need to examine such inter-linked cells with each cell having a structure like that presented in Figure 15.

**Power and Corruption Loop Structure**

Power and control<sup>9</sup> by key personnel is affected by the support they get from both subordinates (loop A) and superiors (via loop D). While subordinates will generally support their boss for reasons discussed in the Boss Employee Relationship Model, superiors will be more likely to support a junior colleague who has power to control new projects, personnel assignments and cash flow. These same factors also strengthen support by subordinates (loops B and C).



**Figure 15.** Loop structure of the Power and Corruption Model. In a corrupt situation the arrow with the question mark will have a negative sign. In that case all of the 27 feedback loops in this structure would be reinforcing loops. Loops presumed to be most important are indicated as darker arrows.

It is likely that supportive colleagues will work to limit factors which might control the power of their beneficiary although this support may be tenuous in some circumstances, particularly if other competing groups are involved, if personalities conflict, or if superiors and colleagues are not corrupt. Some of the issues discussed by Saeed (1996) regarding dynamics of collegial systems might also need to be incorporated into this model view.

A important element in the structure is the sign of the arrow marked with a "?". If the key person is corrupt then this arrow will be negative and loop X becomes a reinforcing loop. If the person is honest then the arrow is positive and loop X is a balancing loop (the person supports factors controlling power) providing some limitation on the growth of power and control.

Rents available will be affected by a number of factors including government control of business ventures, state owned enterprises, natural resource extraction contracts, as well as normal economic growth.

A stock and flow structure for the Power and Corruption Model is still being developed.

## **CONCLUSIONS AND FUTURE PLANS**

These four preliminary system dynamics views of corruption appear to capture key elements of the behavior of corrupt systems which are described in the literature and occur in the real world. It seems likely that a continued effort, including the merging of these models, could assist in clarifying the way in which corruption works and ways in which it can be limited. While significant amounts of corruption modeling have been carried out in the past using various mathematical approaches, the technical knowledge needed to understand and comment on those approaches tends to limit their usefulness except among interested experts. It appears possible that, with a moderate effort, the SD approach could overcome this limitation, and could be used to develop more accurate models applicable to specific situations.

This paper constitutes Part One of what I hope will be an ongoing study. Clearly the models presented here are preliminary. For that reason it is hoped that Part 2 will be the refinement of these models working in cooperation with persons knowledgeable about corruption and those knowledgeable about system dynamics. Following that it is envisioned that Part 3 would take these models into informal, and perhaps formal, settings to discuss further refinement with persons having firsthand experience in corrupt systems. A final Part 4 would use the additional information gained to advise government, aid donors, NGOs and businesses on methods of avoiding and decreasing corrupt practices.



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**Endnotes:**

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<sup>1</sup> Richard Dudley is a fishery biologist with more than 20 years experience working with developing country scientists and managers to better understand, conserve and manage their fishery and related natural resources. His interest in corruption research is a result of his experiences with international development projects.

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<sup>2</sup> Of 99 countries ranked from best to worst using its 1999 Corruption Perception Index, Transparency International ranked Indonesia 96<sup>th</sup>.

<sup>3</sup> Some forms of corruption are not secret. With "grand corruption" and cronyism, favoritism in large business deals involving high officials is often done quite openly.

<sup>4</sup> The term "red tape" is used here as shorthand for overly confusing bureaucratic rules, regulations and procedures.

<sup>5</sup> "Transparency International is a civil society organization dedicated to curbing international and national corruption." Quotation taken from the organization's web page at <http://www.transparency.de/index.html>. 10 April 2000.

<sup>6</sup> An artificial constraint has been placed on the model... the maximum value for the stocks is 10. Without this the stocks would grow exponentially yielding unreasonable values. Nevertheless, corruption could be millions of times as much as the starting value if measured in monetary units. However herein I have chosen to use an approach that measures corruption in terms of good to bad, or in terms of likelihood. In this case the worst that can happen is that all transactions are corrupt.

<sup>7</sup> In the Bribe Likelihood Model I have used the average of the two bribe likelihoods to calculate the amount of total corruption. Some might argue that the product of these two values might be a better option given that both actions, giving and taking, must occur for a bribe to be paid. However, the average value reflects the idea that the effects of corruption also occur even if people who are seeking corrupt activities are not successful.

<sup>8</sup> In a cross-country study of civil service wages and corruption Rijkeghem and Weder (1997) noted that a doubling of civil service wages might lower corruption by 1 point on a 10 point corruption scale.

<sup>9</sup> Power and control as used here may be considered more or less equivalent to the terms monopoly power and discretionary authority as used by some authors when discussing the role of bureaucrats in corrupt practices.

## **Appendix 1 - Additional Information on Model Structure**

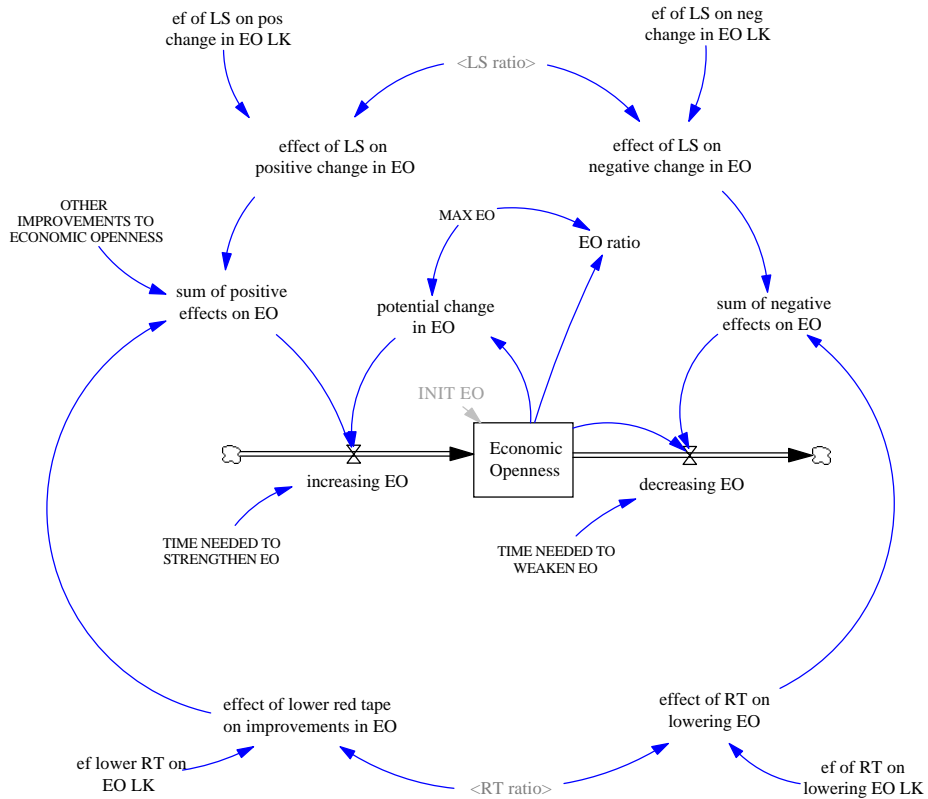
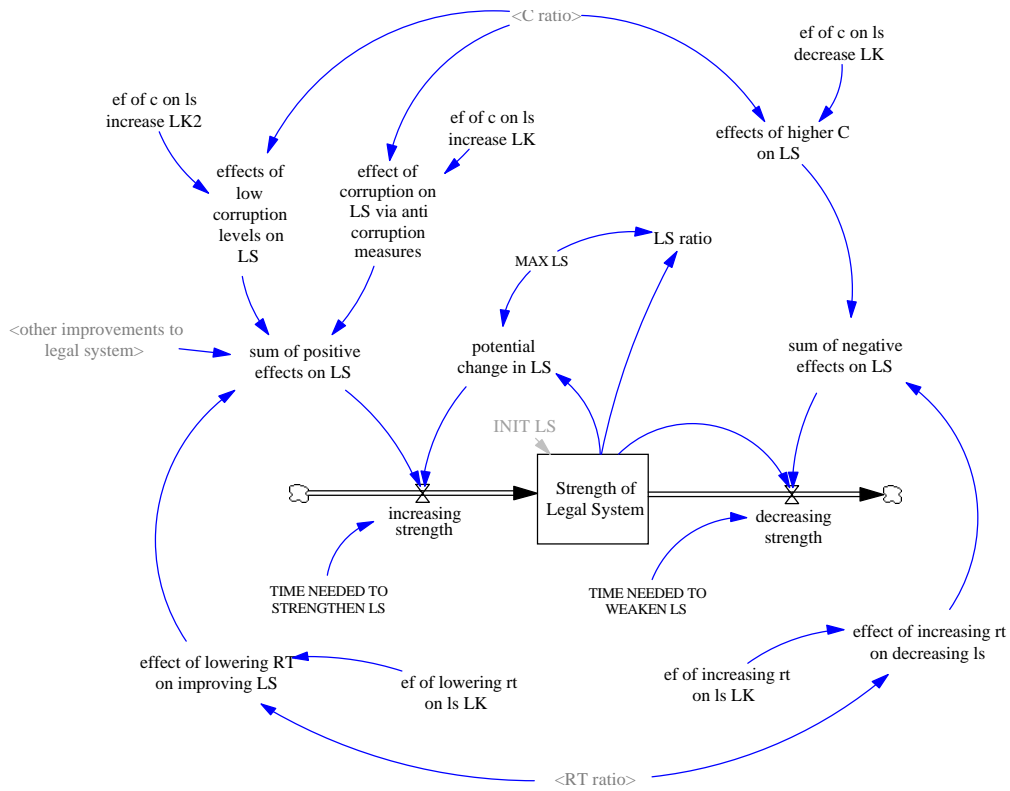
**Red Tape Model**

**Bribe Likelihood Model**

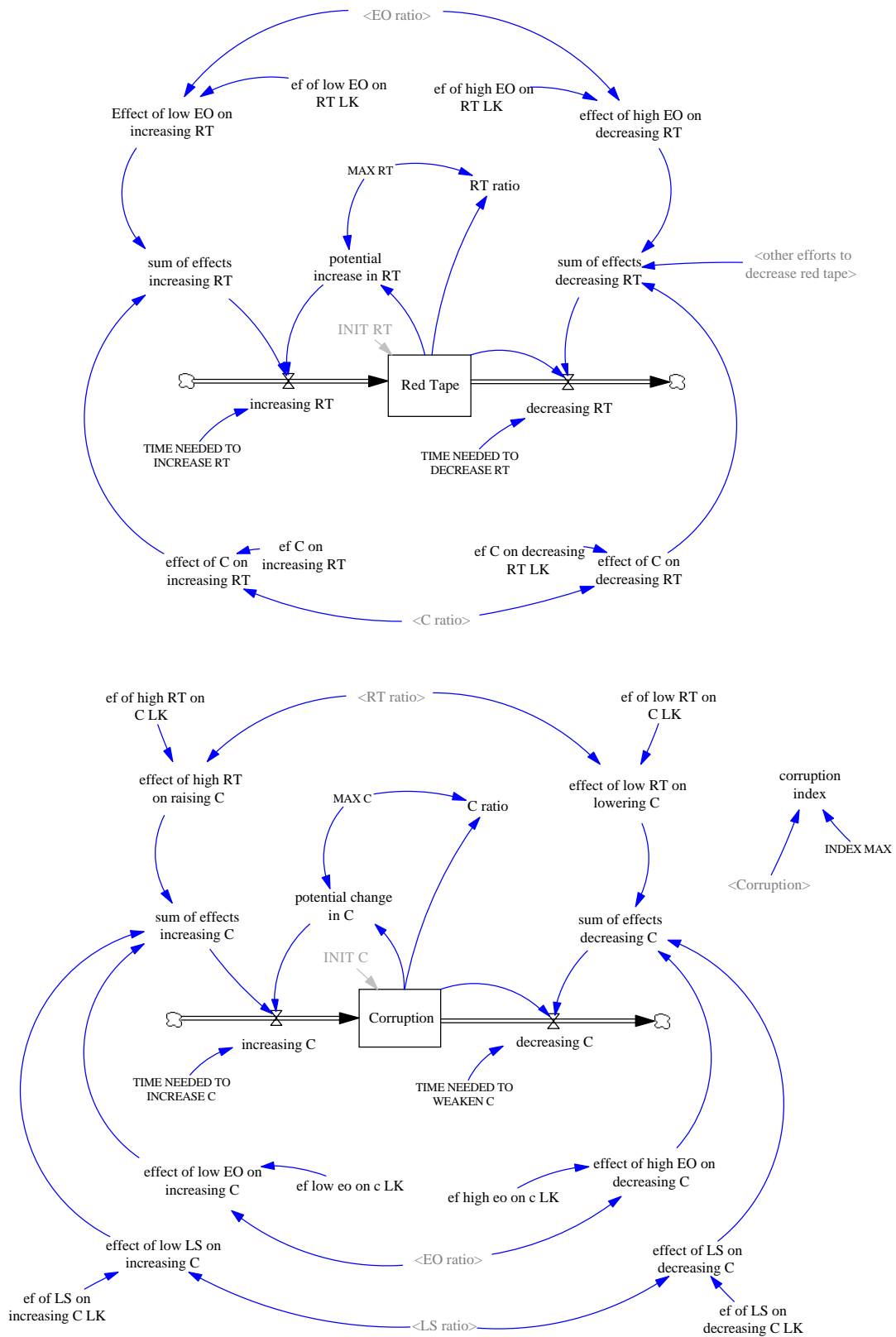
**Employee - Boss Relationship Model**

(Note: Model equations are available from the author)

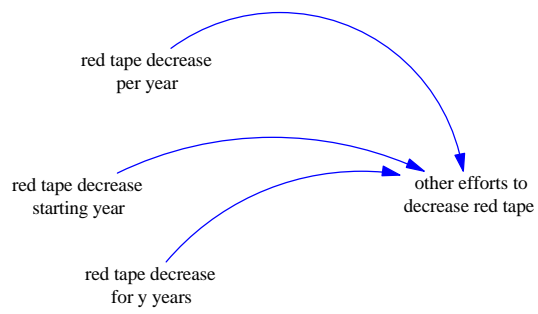
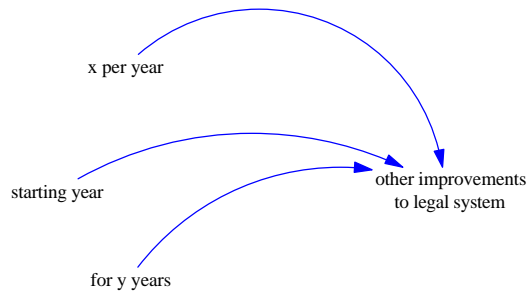
Red Tape Model Structure page 1



**Red Tape Model Structure page 2**



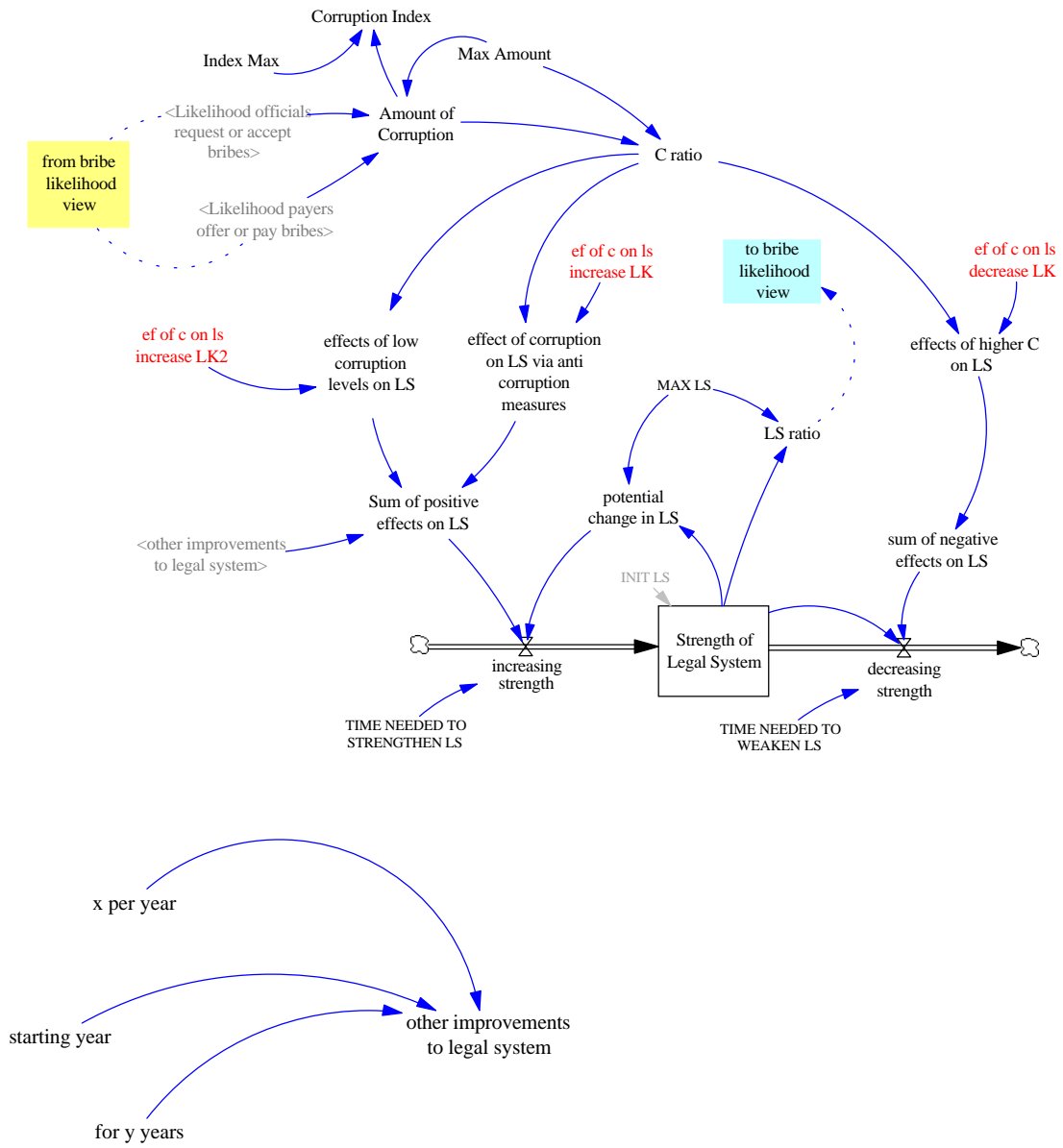
### Red Tape Model Structure page 3



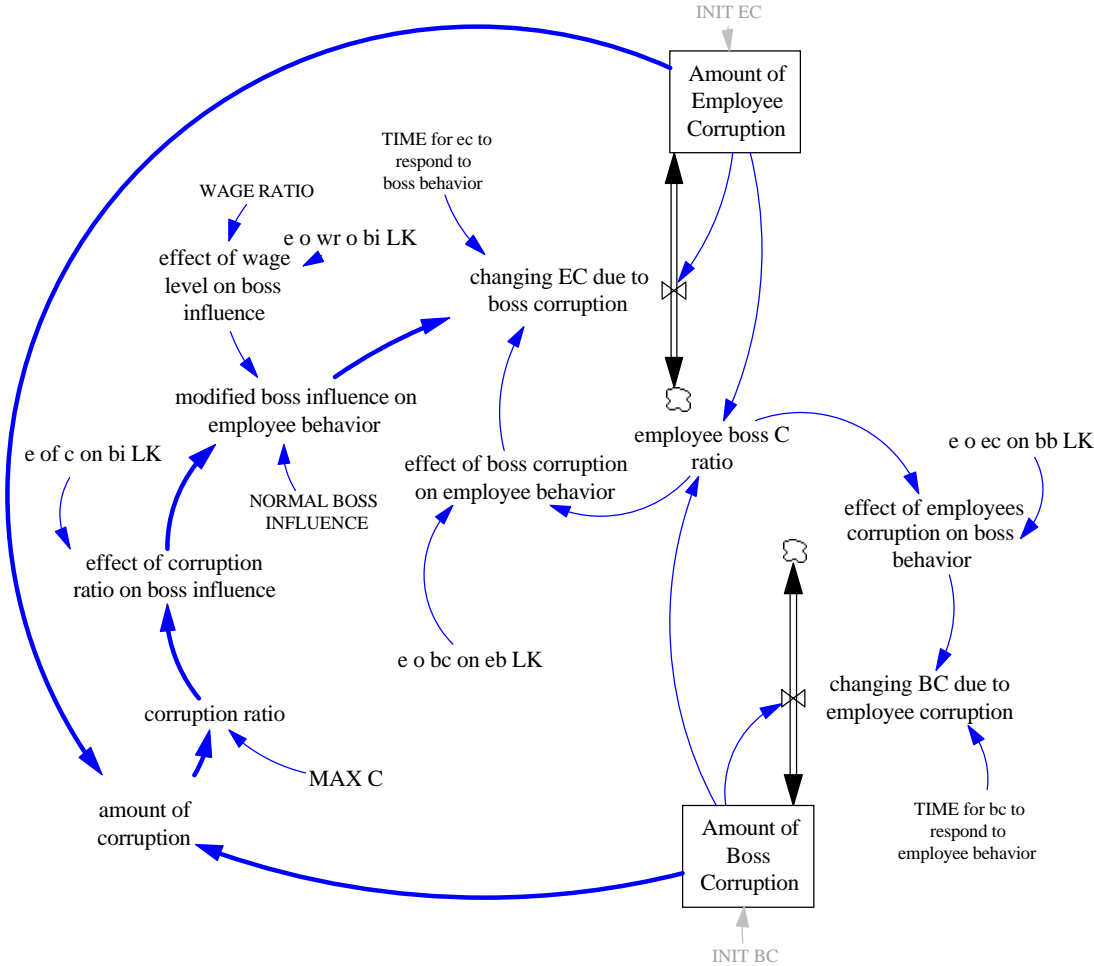




## Bribe Likelihood Model Structure page 2



# Boss Employee Relationship Model Structure page 1



### Boss Employee Relationship Model Structure page 2 - revised model

