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# Hidden Costs of Transactions in a Collaborative Ecosystem

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# HIDDEN COSTS OF TRANSACTIONS IN A COLLABORATIVE ECOSYSTEM

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## Abstract

*Enterprises have evolved from isolated pools of information to becoming parts of a larger system, where collaborating has become a necessity for surviving in today competitive environment.*

*It is generally accepted that collaboration is a key to reducing costs and increasing process efficiency. However, in complex collaborative ecosystems, where a large number of factors are at interplay, the very complexity of the ecosystem introduces performance inefficiencies.*

*These inefficiencies are not visible if the ecosystem is measured from the enterprise perspective, instead of the ecosystem as a whole.*

*We introduce an approach to quantifying these performance inefficiencies, which can result in a cost to each enterprise within the ecosystem. In this study, we have focused on the number of relationships as a source of complexity and quality as a metric for performance evaluation.*

**Keywords:** Collaboration, performance metrics, business complexity, collaborative ecosystem, supply chain relationships, cost of collaboration

## Introduction

Increasing globalization, driven by a consistent need for growth and a search for opportunities to reduce cost, has created a business environment where collaboration is a key factor for success. This driving force, coupled with availability of affordable technological solutions and standards for information exchange, has caused an explosive growth in collaborative solution, both within and between enterprises. Almost every major software vendor has solution offering for workgroups, with a variety of asynchronous and synchronous collaborative tools. Technology vendors are offering the key to inter enterprise collaboration, with myriad services and tools.

However, as the nature of enterprises collaborating at different levels become more diverse, the nature and complexities of collaboration increase dramatically. As pointed out by Lalonde (2000), factors like complex customer –supplier relationships, duration of relationships and extent of technology integration add to the complexity. In addition, Coulson-Thomas (2003), has given weight to factors affecting relationships like increasing globalization, cultural differences and technological variances, which in turn affect the efficiency of the collaborative process.

Barton and Dowdy (1998) and Staufer (2003) have brought out the risk and associated cost of not managing these complexities. In recent surveys (Porter, 1997; Cook and Tyndall, 2001), it has been found that most enterprises suffer huge losses due to inefficiencies of their supply chain, but continue to use rule of thumb to measure efficiencies, rather than go in for hard metrics. Considerable effort has been devoted to understanding the factors that affect the collaborative process; however most of the focus has been on subjective aspects like cultural and procedural differences to understand the effects better (Hardy et.al, 2003; Li and William, 1999; Gray, 2000). It is difficult to find an analytical and metrics driven approach to quantifying these complexities. Although attempts at creating analytical models (Wang, 2000; Baiman et.al, 2001) have been made earlier, the focus has been

either on individual relationships between supplier and customer or on organizational dynamics, rather than looking at the collaborative space as a whole.

Our studies have shown that most of these inadequacies arise due to a tendency to look at collaboration from the perspective of one enterprise and the effects thereof. In reality, a measure of the parameters can be effective only when all the interdependencies are looked at from the point of view of the collaborative eco system as a whole.  To be able to do this, we need to analyze the collaborative ecosystem and then look at the various parameters affecting the eco system.

In this study, we have looked at various parameters affecting the ecosystem and narrowed down on one for a more detailed study. We looked at the effect of the number of relationships on the complexity of the relationship. Within this parameter, we identified metrics that can be easily measured in the real life environment.  A correlation was developed between these parameters.

Based on this correlation, we could infer that a rising number of relationships cause a drop in performance, directly contributing an overhead to the functioning of the ecosystem. We have presented an example of how these changes in metrics contribute to the cost. Finally, we have given a few prescriptive approaches in managing these costs.

## The Collaborative Ecosystem

Our first objective is to have a better understanding of the collaborative eco system. To understand the functioning of a collaborative eco system, it is necessary to identify the nature of relationships that exist in an inter enterprise transaction. Wang (2000) breaks up these relationships in the form of operational, functional, information and physical resource entities. This classification is useful for an analytical understanding, but does not focus on the stakeholders, our principal focus in a collaborative ecosystem.

To focus on the stakeholders, we have classified the relationships broadly into:

— Transactional: (Enterprise to a supplier and enterprise to customer)
— Financial:  (Enterprise to financial stakeholders)
— People: (Enterprise to employee)

When we look at a collaborative model, the relationships themselves become the center of focus, as compared to the earlier view, where the enterprise was the center of focus. This allows us to redefine the relationship in a way, which captures the functioning of the eco system as a whole.

In the collaborative model, we can generalize the relationship to:

1. Transactional: Relationship between supplier and customer.  In a real life scenario, every enterprise will play multiple roles, that of a supplier and a customer, at the same time. From a transaction perspective, every relationship can be broken down to that of either a supplier or customer.
2. Financial: Relationship between financial stakeholder and organization.  The financial stakeholders would be investors in the organization, including both equity and debt. Unlike the enterprise centric view, the financial stakeholder can have multiple relationships within the collaborative environment. For example, a financial investor may have a stake in a supplier and a customer at the same time.

3. People: Relationship between process/ transaction owner and operations.  In the collaborative environment, the transaction owner need not be tied to the enterprise as an employee, but could be an independent entity. For example, a commodity futures trader could be part of a transaction only to hedge a market risk. In an enterprise centric view, the trader activity is manifest as part of the transaction, whereas in a collaborative environment, the trader plays an important part in addressing the cost of operations for the entire operation.

For the purpose of our study, we have focused on the transactional relationship. This is because in today's competitive environment, any method to identify and reduce transactional cost is of value. However, this in no way undermines the importance of the financial and people relationships in the collaborative eco system. To retain the focus of the study, the people and financial relationships would be subjects of a separate study.

At the same time, care needs to be taken while utilizing this definition in creating a transactional model for existing ecosystems. Given the complexity that exists in today's business transaction, it would be necessary to draw boundaries around the definition in the number of supplier and customer to be included. As the complexity of the ecosystem increases, the risks associated with creating a generic model to define a collaborative ecosystem and the resource expended in collecting data for this model may far outweigh the value of the model.

One of the methods of defining the boundary can be based on the size and importance of each supplier and customer. For example, only suppliers and customers contributing more than a certain percentage of value need to be included in the model.

## Source of Complexity in an Ecosystem for Transactional Relationships

As the diversity of enterprises that take part in a collaborative ecosystem increases, the very act of collaboration introduces complexities in the relationships. A recent study by Hauguel and Jackson, (2001) and studies on the tradeoffs between flexibility and uncertainty (Prater et.al, 2001) highlight some of the aspects of complexity in supply chains. These complexities in turn have a potential to disrupt the smooth functioning of the ecosystem.

The possible sources of complexity can arise out of

- Number of relationships in the ecosystem
- Geographical spread – a large geographical spread introduces complex logistical issues
- Differences in infrastructure and operating method – a supplier with limited information system infrastructure can be a bottleneck in the collaborative process.
- Environmental factors – the nature of the ecosystem is driven by environmental factors, like in nuclear fuel processing plants.

In addition, there are factors that are external to the ecosystem (Stauffer, 2003), which also contribute to the complexity. Some of these factors are

- Regulatory factors – In the healthcare and pharmaceutical sectors, regulatory requirements creates a constant pressure on the ecosystem.
- Sovereign risks – When the collaboration extends to enterprises sourcing materials from nations having high sovereign risk, the risk vs. cost benefit has to be looked into more deeply.
- Technology obsolescence  – In cases where the value creation by the ecosystem is dependent heavily on a technological innovation, a large risk of the technology becoming obsolete remains.
- Price risks

As these factors are external to the ecosystem, it is more difficult to control them. Any changes to these factors affect the ecosystem to varying degrees. A proper understanding of the factors needs to be done to create a comprehensive risk management plan for the entire ecosystem.

In real life scenarios, all the above factors contribute to the complexity, in varying degrees. It is nearly impossible to quantify the dependencies in a generic manner, and each ecosystem has to be studied separately to arrive at this complexity.
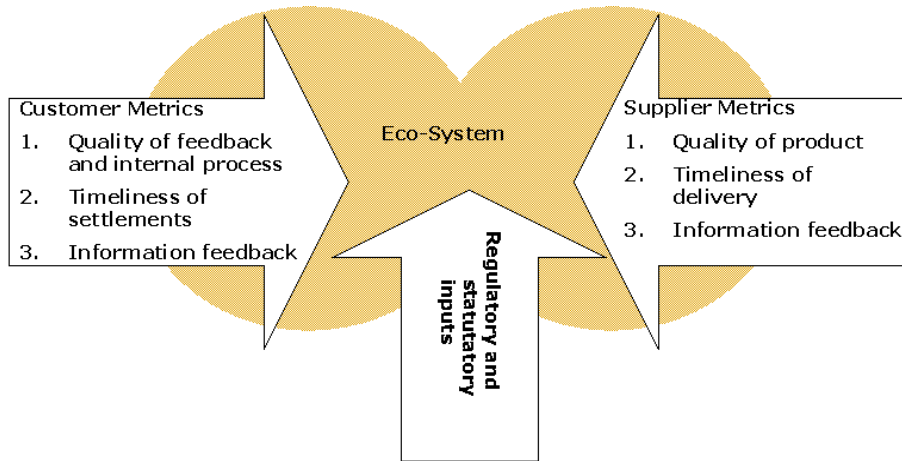
**Figure 1.  Factors Affecting a Complex Ecosystem**

# Quantifying Complexity Arising out of Number of Relationships

For the purpose of our study we have considered only the number of relationships as a contributing factor to the complexity. This is an attempt at quantifying the complexity using measurable parameters.

The complexity of relationships arising from the number of relationship can range from the simple (one supplier and one vendor) to the complex (each supplier has many customers, and each of the customers in turn have multiple suppliers). An example of the complexity of the relationships is aircraft supplier Boeing, which, in 2001, had over 15,000 non-production supplier (Hannon, 2001). These were suppliers that were not directly supplying to the production of airplanes. In a scenario like this, non-specialized suppliers like stationary suppliers and maintenance contractors were not exclusive to Boeing and had multiple customers. These would result in multiple supplier customer relationships, and is illustrated below in the diagram.
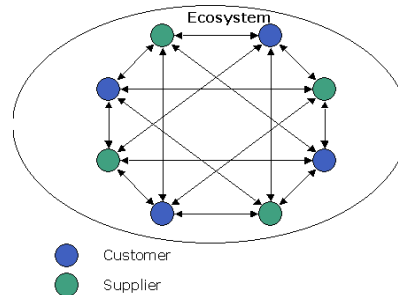


**Figure 2.  Illustration of a Complex Relationship of
Customers and Suppliers in an Ecosystem**

By defining a simple matrix of number of customers and suppliers, we can arrive at a quantitative measurement of the complexity. The number of possible relationships that one customer can have with $N_s$ suppliers is $N_s$. Then the number of possible relationships in an ecosystem with $N_c$ as the number of customers and $N_s$ suppliers is $N_s*N_c$. The following table illustrates the maximum number of possible relationships in an ecosystem for a given $N_s$, $N_c$. This assumption has been made for the purpose of simplicity in the model.

**Table 1.  Illustrative Matrix of Maximum Number of Possible Relationship between Customer and Supplier**

| | | # of Customers ($N_c$) | | |
| | | 10 | 20 | 30 |
|---|---|---|---|---|
| # of Suppliers ($N_s$) | 10 | 100 | 200 | 300 |
| | 20 | 200 | 400 | 600 |
| | 30 | 300 | 600 | 900 |
| | 40 | 400 | 800 | 1200 |
| | 50 | 500 | 1000 | 1500 |

## Metrics to Measure Performance of Ecosystem

In dealing with the ecosystem consisting of multiple enterprises interacting with each other, it is apparent that we need quantitative measures to be able to judge the performance and effectiveness of the ecosystem as a whole, and not just of individual enterprises. Given the loose coupling between the enterprises, it is critical that the metrics conform to certain basic requirements, namely:

— They should be measurable to a reasonable degree of accuracy and repeatability.
— The metrics can be generalized to most ecosystems.
— It should be easy to incorporate the metric measurement as part of the normal business process.
— The act of measurement of the metric should not disrupt any business process or transaction.

To arrive at metrics that would conform to the above requirements, we need to identify globally applicable metrics, not restricted to any industry or process. The major metrics that are applicable across any ecosystem would be

— Quality (quality of the service / product delivered; quality of response).
— Time (time spent in non value added services by members of the ecosystem).
— Cost (Cost of producing and delivering the service / product; Cost of managing the relationships within the ecosystem)

## Quantifying a Change in Performance

For the purpose of the study, we have used a sample set of Quality related metrics.  It is difficult to quantify quality in a generic manner, since an element of subjectivity cannot be removed.  At the same time, a consistent high quality is of importance to the success of the ecosystem. Six attributes generally used for performance evaluation are identified and used in a study by Mummalaneni, *et al.* (1996).

These attributes are: on-time delivery, quality, price/costs targets, professionalism, responsiveness to customer needs and long-term relationships with the purchasing company.

We have further extended these metrics to map to the role of the enterprise, namely that of a supplier or a customer. The metrics have been selected on the basis of their potential variation due to the number of relationship in an eco system.

Metrics to evaluate customer

— Settlement delays
— Order errors
— Repeat orders not automated
— Insufficient lead time

Metrics to evaluate supplier

— Transparency of pricing information
— Complacency affecting delivery

— Product Quality leading to rejections
— Feedback

These metrics can change either positively (denoting an increase in quality) or negatively (denoting a decrease in quality). A % change in each of the metrics (for e.g. order errors increase from 5% to 7%, contributing to a 2% drop in quality of service) due to an increase in the number of relationship will directly affect the performance of the ecosystem. For each supplier or customer, the total change in performance is the cumulative change for the specified parameters.

The formulae used to arrive at the relationship is

$$P= P_c*N_s+P_s*N_c$$

where    **P**= Total % change in performance for the ecosystem as a whole
   **P_c**= Cumulative % change in performance for customer based on supplier metrics
   **N_s**= Total number of suppliers in the relationship
   **P_s**= Cumulative % change in performance for supplier based on customer metrics
   **N_c**= Total number of customers in the relationship

The formula is explained in more detail in the Appendix, under the section by the same name.

For negative changes in the metrics, we notice that the cumulative drop in performance rises much more sharply with a corresponding increase in complexity. Correspondingly, a positive change in the metrics will reflect a higher gain in performance. This indicates that even if the performance drops linearly with increasing number of relationship, the cumulative effect on the ecosystem is a lot more drastic. This result has strong implications on the management of the ecosystem as a whole.
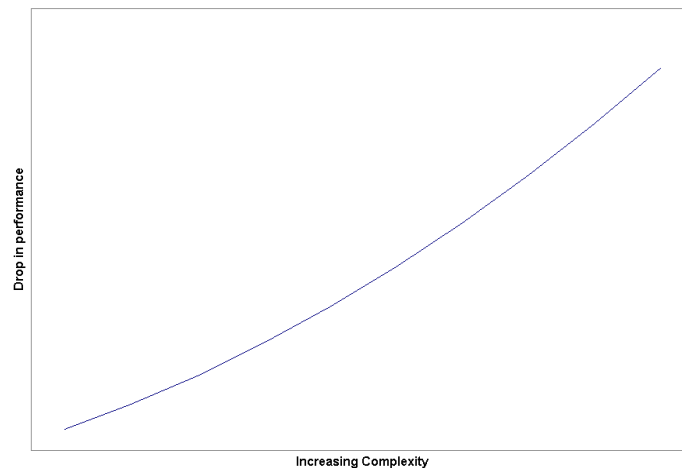


**Figure 3.  Correlation Between the Drop in Performance to the Complexity of the Relationship for the Entire Ecosystem. The Graph Uses Simulated Data.**

## The Hidden Cost of Transaction

### *Analyzing the Origin of the Cost*

A drop in performance has a direct effect on the bottom-line.  In today's tough economic environment, more focus is on managing costs than ever before. From the customer viewpoint, any complacency in delivery or rejection of goods will translate into a cost. Conversely, from the supplier point of view, an error in ordering by the customer will cause lower supply of materials, which in turn can affect the entire production cycle.

In addition, an indirect cost is also introduced, as resources need to be allocated to improve the performance of the metric. For example, if the metrics described above changes the following results and consequent actions could be taken:

| Metrics to evaluate customer | Result | Consequence |
|---|---|---|
| Settlement delays | Supplier cash flow will be affected | Initiate communication with customer until settlement is completed. Resources need to be diverted to settle the issue |
| Ordering errors | Rejection of goods | Recall the consignment. In case of dispute, resolve across the table. Resources need to be diverted to settle the issue. |
| Repeat orders not automated | The supplier is not aware of the repeat order so cannot automate the process | Increase in cycle time. Production cycle for customer held up. Customer resource lie idle. |
| Insufficient lead time | Insufficient time to process goods | Delay in processing goods. Customer resources lie idle. |

Looking at the supplier side of the same equation, we can arrive at a similar Metric – Result – Consequence tabulation.

| Metrics to evaluate supplier | Result | Consequence |
|---|---|---|
| Transparency of pricing information | Customer forecasting does not reflect true picture | Initiate communication with supplier to find correct pricing. Resources need to be diverted to settle the issue |
| Complacency affecting delivery | Customer production is affected | Delay in processing goods. Customer resources lie idle. |
| Product Quality leading to rejections | Customer production is affected | Delay in processing goods. Customer resources lie idle. |
| Feedback | Insufficient feedback from supplier lead to delays in decision taking | Initiate communication with supplier to find updated information. Resources need to be diverted to settle the issue |

As is evident from the above two examples, te result of the metric change drive the consequence.

The consequences directly affect the cost by

— Diverting resources from what they were originally allocated for
— Underutilization of resources by forcing them to be idle

As was pointed out in the earlier section, from the point of view of the entire ecosystem, an increase in the number of suppliers (or / and customers) will cause a larger proportionate decrease in overall performance, than the actual increase in the number of suppliers (or customers). This leads us to an interesting corollary. The cost increase (assumed to be in direct proportion to the change in performance metric for each individual supplier or customer) will also increase in a larger proportion than the actual increase in the number of suppliers or customers.

As this cost is not evident from the enterprise centric view of transactions in a collaborative environment, we have termed it as the *hidden cost of transactions in a collaborative ecosystem.*

## Managing the Cost

Clearly, as the number and nature of relationships cannot be changed, our prescription lies in managing these complexities better. The three critical aspects in managing these complexities are:

1. **Awareness**: The members of the ecosystem should be aware of the pitfalls of an increasing number of relationships. In collaborative environments, it is common to assume that the act of collaboration is inherently efficient. The awareness of the potential problem is a large step forward.

2. **Automated Metrics**: As described in an earlier section, a key to successful metric is the ease with which it can be measured without disrupting the normal business cycle. With the proper definition of the metrics and an automated method of measuring it, performance can be routinely monitored and preemptive action can be taken

3. **Adaptive processes**: The processes that the members employ should be able to adapt to increasing pressures of large transaction volumes. They should also be able to dynamic changes in partner relations. For example, adding a supplier to the ecosystem should not involve elaborate processes. More elaborate the process, the more chances exist for the supplier to under perform.

## Conclusion and Further Research

To be able to quantify the effects of the various factors in a complex collaborative relationship, it is necessary for us to understand the nature of the relationship as a whole and then work at factors that affect the relationships. With most of the factors having cascading effects on the collaborative environment, it is counterproductive to look at any of the factors in isolation and arrive at a solution based on isolated parameters. As described in the last section, some of the aspects form the basis for creating solutions to manage the costs. The solution could be a mix of process changes, policy modifications and technology inputs.

At this stage we are only beginning to explore the potential source of complexities in a transactional collaborative environment. A more rigorous treatment will help us quantify some of the other factors and enable us to create a more comprehensive model to measure the overheads in the eco system.

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# Appendix: Quantifying a Change in Performance

The method of quantifying a change in performance is described using an example below

Supplier $S_1$ supplies to customer $C_1$. On an average, the performance of $S_1$ changes on adding every customer, in the way described below. Now, 1 in every 1000 pricing request is not provided correctly, 5 in 10,000 items to be delivered is delayed and so on.

| Parameter | %Change |
|---|---|
| Transparency of pricing information | -0.1 |
| Complacency affecting delivery | -0.05 |
| Product Quality leading to rejections | -0.01 |
| Feedback | -0.1 |
| Total ($P_{s1}$) | -0.26 |

$S_1$ now begins to supply $C_1$ through $C_{10}$. With an increase in the number of customer, there is a proportionate decrease in the performance of the supplier.

As the number of customers increase, the perceived drop in performance is going to increase proportionately. Hence, if $P_c$ is the % drop in performance for $S_1$ as perceived on a cumulative basis by all the customers, then $P_c$ increases over $Ps_1$ by a factor K, where K is a factor based on the number of customers ($N_c$).

$\mathbf{P_c = Ps_1 + Ps_1 (K)}$,
This implies $\mathbf{P_c = Ps_1 (1 + K)}$,
Which can be represented as $\mathbf{P_c = P_{s1} (1 + \Phi N_c)}$, where $\Phi$ is a constant.

Similarly, we can arrive at the variation as perceived by a supplier, denoted by $P_s$. If $P_{c1}$ denotes the change in the customer metrics, in its interaction with the supplier, then

$\mathbf{P_s = P_{c1} + P_{c1} (M)}$
This implies $\mathbf{Ps = Pc_1 (1 + M)}$,
Which can be represented as $\mathbf{P_s = P_{c1} (1 + \Omega N_c)}$, where $\Omega$ is a constant

In an ecosystem with $N_s$ suppliers and $N_c$ customers, the total drop in performance can be calculated by

$P = (P_c + P_c + P_c + \ldots N_s \text{ times}) + (P_s + P_s + P_s + \ldots \ldots N_c \text{ times})$
$\mathbf{P = P_c * N_s + P_s * N_c}$

For the purpose of the graph displayed above, we used simulated data for the performance metrics. The factors $\Omega$ and $\Phi$ were fixed at 0.01, and the $N_s$ and $N_c$ were capped at 100 each, with increments of 10.

The data has been used to generate the graph depicted in Figure 3.