

**Merck's Foreign Exchange
Risk Management**

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Table of Content

| | | |
|---------|--|----|
| 1 | INTRODUCTION..... | 3 |
| 2 | FOREIGN EXCHANGE RISK MANAGEMENT | 3 |
| 2.1 | The Problem..... | 3 |
| 2.1.1 | The Foreign Exchange Markets..... | 3 |
| 2.1.2 | Risk Management vs. Speculation..... | 5 |
| 2.2 | Intra Corporate Transactions..... | 5 |
| 2.3 | Information Used to Manage Foreign Exchange Risk..... | 5 |
| 2.3.1 | The FIN1B: How much exposure do I have?..... | 7 |
| 2.3.2 | CitiLondon: What are the intra-corporate transactions? | 7 |
| 2.3.3 | MCM Information Manager and Models: What Contracts do I Have Open?..... | 8 |
| 2.3.4 | Reuters: What's Happening in the Market Now? | 8 |
| 2.3.5 | Direct Bank Contact: Where Might the Market be Going? | 8 |
| 2.3.6 | In-House Lotus Models: What Should I do Today?..... | 9 |
| 2.4 | The Integration of Data in Merck's Risk Management Function..... | 9 |
| 2.4.1 | Intra-Source Integration of Data..... | 9 |
| 2.4.1.1 | Integration of FIN1B Information | 9 |
| 2.4.1.2 | Intelligent Information Retrieval..... | 10 |
| 2.4.2 | Inter-Source Integration of Data..... | 10 |
| 2.5 | Conclusion..... | 11 |

List of Figures

| | | |
|-----------|-----------------------------|---|
| Exhibit 1 | Sources of information..... | 6 |
|-----------|-----------------------------|---|

1 INTRODUCTION

Merck Inc. engages in the research, development, manufacture, and marketing of a wide range of pharmaceutical products. A New Jersey-based corporation, Merck markets its products throughout the world. In 1988, they sold \$6 billion worth of their products in 151 different countries, with a net income of \$1.2 billion. While this easily earned them top ranking within their industry, Merck was further honored in 1987 as the "Best Company in America" to work for.

As might be assumed from their cutting-edge culture, Merck's use of technology is widespread, ranging from their research and development labs to the marketing, business intelligence function and financial control operations.

This case study will focus on the use of information systems, particularly the integration of heterogeneous data, in one sub-function of financial control: the management of foreign exchange risk.

2 FOREIGN EXCHANGE RISK MANAGEMENT

2.1 The Problem

Merck is a multinational corporation (MNC) with successful operation in many countries and cultures. It takes full advantage of its MNC status by maximizing its profitability as a whole (*ie.* cutting across boundaries all US and overseas operations) rather than as the sum of each countries' profitability. This optimization is achieved through operational and financial controls. More details on the financial optimization can be found in later sections.

All the overseas sales are made in the local currencies or an equivalent currency for that location (called the *currency proxies* – which will be discussed in the later section). However, the bulk of the expenses of Merck is in research and development. All these activities are based in the U.S.. Therefore, some of the non-U.S. dollars revenue would have to be converted to U.S. dollars to fund these vital research and development activities. The conversion is also necessary for accounting purposes.

Given the turbulent macro economic landscape, in which interest rates and foreign exchange rates are constantly rising and falling in response to factors such as changes in national fiscal policies, monetary policies, shifts in the magnitude of perceived sovereign risks, as well as the underlying supply and demand characteristics of the currency, Merck's final *dollar-denominated* profit would be extremely hard to predict at any given time throughout the year. As a result of these swings in potential earnings due to powerful exogenous (from Merck's point of view) factors, and like many companies operating across national boundaries, Merck undertakes to stabilize their expected return through the use of foreign exchange forward contracts. In fact, there is currently a function within the Financial Control Department at Merck dedicated solely to the management of this specific risk.

2.1.1 The Foreign Exchange Markets

To put it as simply as possible, one can buy foreign exchange (FX) in either the "spot" market or in the "forward" market. The difference between the two markets essentially lies in when actual transactions of the markets will be consummated. For example, suppose we need FFR6.3 million in two business days' time so as to pay a supplier. We can buy the FFR by committing to a spot FX contract with our banker at a specific exchange rate of say, US\$1 to

FFR6.3. Then we are liable to pay our banker in 2 days' time US\$1 million in exchange for FFR6.3 million. On the other hand, suppose the payment is due in a month's time. Fluctuations in FX rates for the next one month may lead to additional gain or loss. If we do not wish to leave ourselves exposed to such fluctuations, we can buy the FFR6.3 million in advance from our Banker at the prevailing 1 month's forward FFR to US\$ exchange rate of say, US\$1 to FFR6.0. In one month's time, we are liable to pay our banker US\$1.05 million in exchange for FFR 6.3 million regardless of the prevailing spot exchange rate at that time. This different time profile means that spot foreign exchange and forward foreign exchange each can have very different uses, particularly in risk management.

The forward exchange market can be used as an effective vehicle to "hedge" foreign exchange risk. "Hedging" is a term used to describe the attempt to offset any future losses with an opposite gain. Very often the payment for this, of course, is the offsetting of any future gains with a loss. However, it is the assumption of a known loss today in exchange for the mitigation of uncertain losses in the future which makes hedging such a popular and important financial management strategy.

The key to hedging is the counter-cyclicity of the *hedging* vehicle with respect to the *hedged* vehicle, which is presumably reaping risky returns in the future. As a simple non-financial illustration of this counter-cyclicity, many Sunday gamblers use this technique in betting on football games. Assume that the Chicago Bears were playing the New England Patriots, and I had already committed to bet \$1,000 on the Bears at even odds. Later, noting the perfect counter-cyclicity of the two sides (a loss to the Bears is a gain for the Patriots and vice versa), I might decide to hedge my bet by placing a \$200 bet on the Patriots at 4:1 odds. As should be clear, this would decrease my risk outstanding by offsetting potential future losses (in the unlikely case of Patriots win) with a gain. It would also decrease my return, however, if the Bears turned out to be the victors.

This same strategy is used at Merck to control their foreign exchange risk through the use of foreign exchange forward contracts. A simple example will serve to demonstrate how this strategy is executed. Given Merck's multinational nature, it would not be hard to imagine them having an expected "contribution" (pharmaceutical sales less any local, mainly marketing, expenses) from say, France, of FFR20,000,000 per month. However, being an American company, Merck wants this in dollars at say, the end of each month. However, given the fluctuation in the \$/FF exchange rate due to the factors listed above, this month-end conversion could translate into an extremely wide range of gain or loss in dollar value, depending on what the rate was at the time of the conversion. This is where the use of forward contracts can be of great help.

The actual structure of the contract may be a bit confusing, however, and will depend on the total "exposure" Merck has in a given currency. Using the above example, Merck would suffer a loss if the value of the French franc dropped prior to their conversion (which would mean that the franc could "buy" fewer U.S. dollars). To manage this potential risk of a loss, Merck might thus enter into a forward contract to sell French francs for a given rate in the future, preferably at the time the offsetting conversion of francs to dollars will take place. Why this is a hedge should be clear at this point. Should the franc's value drop vis-a-vis the dollar, then the dollar value of the converted revenue stream will obviously drop accordingly. However, this loss will be offset by gains attributed to the forward contract. Merck would gain on this contract because, theoretically, as the holder of this contract, they could buy francs in the spot market (at the now lower price) and sell them on the contract date (at the higher price) and make a profit. Of course, in the case of an appreciated or revalued franc, the above scenario is reversed with any conversion gains being offset by losses in the forward market.

While this example may have been very simple, the management of foreign exchange risk in this manner is not trivial. For example, the future expected course of the franc is already built into the forward price. Therefore, the hedger must take this course into account when predicting future expected gains or losses. Also, there may not be active forward markets in some of the currencies which the company receives from its foreign subsidiaries. Merck is a good example of such a company. In this case, the hedger must use "proxies" for some currencies. That is, they look for a basket of currencies that "behave" like the non-active currencies. The process of finding a proxy often involves the tedious calculation of statistics such as cross-elasticities. Further, there may not be a proxy that is suitable.

.c.2.1.2 Risk Management vs. Speculation

This discussion might also have hinted at the potential gains one might make in correctly charting the future changes in the values of certain currencies on both the spot and the forward markets. This is true, but like getting involved in the options market, the risks are also extremely high. Merck thus limits itself to the practice of strictly hedging its expected conversion and does not get involved in pure speculation. That is, they view this as solely a risk management function and therefore all positions taken, and contracts entered into, are done so as a result of a revenue position (and therefore "exposure") in some foreign currency. On the other hand, a speculator would enter into positions based solely on an expected favorable movement in the underlying markets. Modern Corporate Financial theorists, in fact, would likely support this restriction of hedging activities as the owners of Merck (the stockholders) can engage in foreign exchange or interest rate speculation on their own if they so desire or refrain from doing so as they choose.)

2.2 Intra Corporate Transactions

Merck maximizes profit at the highest level rather than at any sub-level. Doing so allows Merck to take advantage of the various tax laws and financial characteristics specific to each of the countries in which they operate. For example, if France was favorable to businesses in that they had a low tax rate, it would seem logical that, *ceteris paribus*, a company would want to "make money" in France rather than in some other country with a higher tax rate. Of course, "making money" does not necessarily mean having extensive operations in that country; it may simply mean the recognition of profits from non-French subsidiaries in France. In order to fully take advantage of these (changing) characteristics, Merck performs extensive and centrally-controlled intra-corporate transactions. These all take place at carefully calculated transaction prices. These prices are designed to take advantage of country-specific characteristics and maximize the overall profit of the entire company.

2.3 Information Used to Manage Foreign Exchange Risk

The ultimate questions that the Merck risk manager wants to answer when she makes a decision are the following:

- "Should I roll over the contracts that are due?"
- "Should I enter into new contracts?"
- "What should be the size of the contracts?"
- "What should be the duration of the contracts?"

The management of foreign exchange risk is an information-intensive activity. Exhibit 1 shows the basic sources of information that the risk manager uses each day to answer the above questions. In this section, I will describe each of the information sources and the crucial pieces of information they provide. In the next section, I will conclude by discussing possible

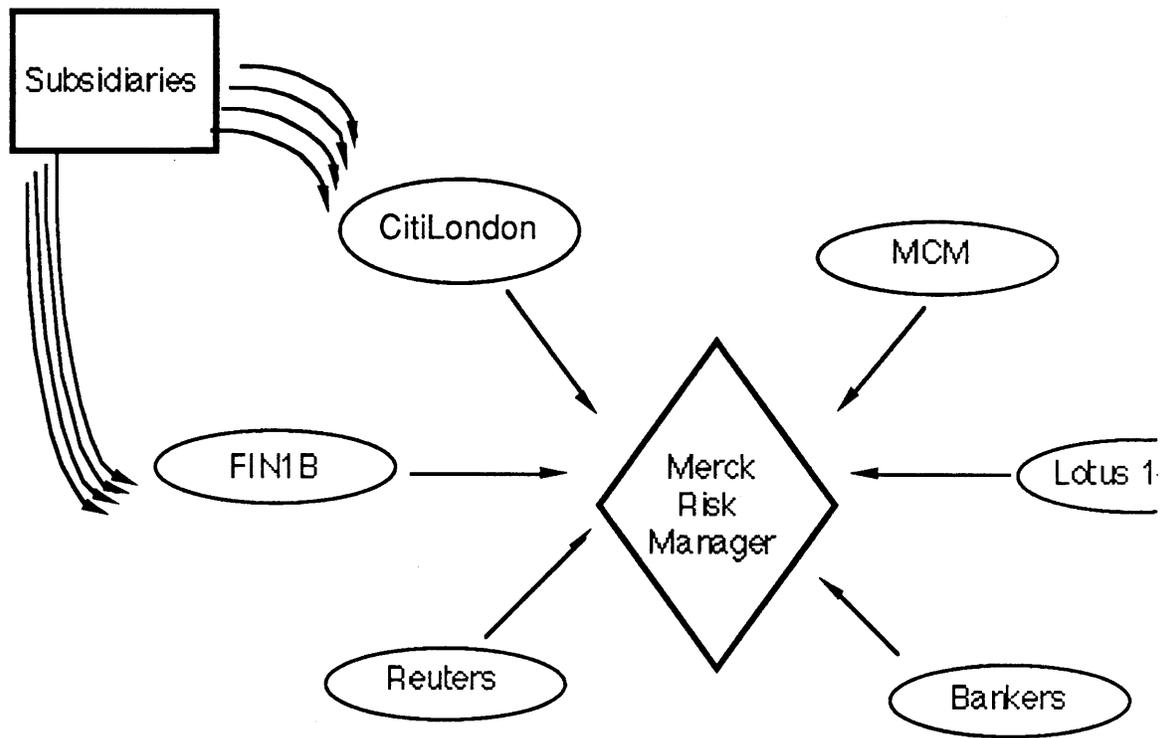


Exhibit 1 Sources of information

mutual interests between the risk management function and the risk management function as performed at Merck.

2.3.1 The FIN1B: How much exposure do I have?

The FIN1B database is the first input into the hedging decision. It holds the information concerning Merck's financial position and exposure in each of the foreign subsidiaries as listed in their local (or equivalent) currencies. This is a monthly report which is received via mail by the Financial Control Department and forwarded to the risk manager. There are several interesting things about this database:

- It is input manually twice. The relevant information is first received by the Financial Control Department within the first few days of each month. This information is in hard copy form. The Department then manually inputs it into an ADABAS DBMS for storage. The FIN1B is then printed and sent to the risk manager. Here, it is manually input *again* into a Lotus 1-2-3 spreadsheet for her own use. While this may seem like many unnecessary manual steps, the departments do *not* feel that the amount of work required for it is overwhelming or in need of automation.
- Much of the information sent by the foreign subsidiaries concerns *expected* future exposure.

My impression is that the risk manager considers two mitigating effects to cope with this uncertainty. First, there may be some "adjustments" performed at the centralized Financial Control Department located in New Jersey. These would take place as it became obvious that the earlier reported figures were in error. Second, these errors should statistically even out in the end. Of course, this assumes that the errors will be unbiased.

Further, it assumes that Merck's gain or loss is exactly the same for equal but opposite errors. The main point, however, is that any given exposure figure is not likely to be exactly correct.

The risk manager combines the exposure reports from various foreign subsidiaries into one consolidated report in the form of a Lotus 1-2-3 model. The model contains details about the exposure for Merck as a whole in each of the various currencies. Merck must first be able to net out the intra-corporate transactions to perform this consolidation. This is the task of the CitiLondon information system to be discussed next.

2.3.2 CitiLondon: What are the intra-corporate transactions?

As its name suggests, this is an information system provided by and operated by CitiCorp's London office. The main function of the system is to report, and net out (*ie.* eliminate), the complex web of intra-corporate transactions that large MNC's like Merck make use of in their day-to-day operations. Differing local tax laws and other financial characteristics provide Merck with an opportunity to take advantage of its cross-border presence by recognizing revenues and expenses in such a way that its overall profit is greater than what it might be if each foreign subsidiary does its own recognition. Thus, many intra-corporate transactions take place through CitiCorp's worldwide locations. Using the bank's hardware and expertise, CitiCorp can consolidate the information about these transactions for their MNC clients. This information is clearly essential to Merck as it allows it to capture its overall exposure and therefore hedge it for the company as a whole.

The CitiLondon information is transmitted via modem from CitiCorp's London office. I am not sure how the intra-corporate transactions are identified and eliminated, and whether the data can be downloaded from the network to the storage devices of a personal computer.

2.3.3 MCM Information Manager and Models: What Contracts do I Have Open?

Another source of information used extensively is provided by the MCM system. This system has an information management module, an economic and news database, and a modelling module.

- The *information management* module seems to be used very extensively. It consists of a program which allows the risk manager to track her currently outstanding forward contracts. It can also provide the relevant information about these contracts (eg. counterparty, rate, expiration, currency). I am not sure how the data is entered into the system.
- The *economic and news database* is available, via modem. The economic data includes both current and historical financial information. For instance, it includes current spot and forward exchange rates. However my impression is that the rates provided are inferior to those obtainable elsewhere (ie. from Reuters, or directly from banks).

Therefore, the information is seldom used to make contract purchase decisions. Another reason for this low usage is the non-intuitive mode of access for historical information. Finally, it seems that the text retrieval capabilities provided with the news service are fairly sophisticated. However, the news coverage is limited. Therefore, the service may be used for a specific query, but it is not the main source of news used by the risk manager.

- Finally, the *models* provided by MCM seem to fall into the "nice, but not really necessary" category. They include valuation formulas and hedging strategies which would translate into buy-don't buy and amount figures. In fact, Merck is currently developing its own in-house optimal hedging model which, it is assumed, will be more applicable to their conservative hedging goals.

2.3.4 Reuters: What's Happening in the Market Now?

The Reuters news feed seems to be the main source of information for monitoring occurrences in the foreign exchange market on an ongoing basis. Reuters provides an extensive news service which is easy to use and fairly comprehensive. It is clear that this is used for news monitoring a great deal more than MCM's service. It is important to note, however, that the final rates on which the risk manager will make a decision come not from Reuters. They come from direct contact with the bankers due to the nature of the foreign exchange business.

2.3.5 Direct Bank Contact: Where Might the Market be Going?

This is the most crucial source of information for the risk manager. While Merck has banking relationships with about fifteen banks, there are approximately six to seven with whom the risk manager has what could be described as a "strong working relationship." This information exchange includes daily discussions with the economists of each of the six or seven banks concerning the general macroeconomic landscape and the specific risk profiles of any particular currencies in which Merck may be interested, as well as the available rates on a real-time basis.

Information is exchanged via telephone conversations. The media of exchange is verbal because there is no electronic link between Merck and its bankers.

2.3.6 In-House Lotus Models: What Should I do Today?

Finally, the relevant information from the MCM information management system (showing Merck's positions) and that from the FIN1B's (showing Merck's exposure) are combined manually, as stated above, into a Lotus 1-2-3 model which maintains the net exposure in each currency and serves as an information source for the final roll-over decision.

2.4 The Integration of Data in Merck's Risk Management Function

Data Integration is certainly a common function performed by the Merck risk manager. The manager must integrate all of the above types of information and output answers to the questions set out at the beginning of Section 2.3. Given this, I have split the integration issues of interest to CIS/TK research into two separate sections: intra-source integration and inter-source integration. Clearly, the former is generally performed prior to the receipt (or at least processing) of the information by the risk manager, while the latter is performed by the manager.

2.4.1 Intra-Source Integration of Data

2.4.1.1 Integration of FIN1B Information

As was outlined above, the financial control department receives information in hard copy form each month from each of the subsidiaries concerning the past, current, and future financial performance of the subsidiary. This information is then manually input into an ADABAS database. My impression is that one of the reasons for the manual integration of this data (as opposed to modem- or floppy-based integration), with all of the potential there is for human error, is the fact that the data comes in a variety of different formats, technical and otherwise, from each area.

If it is not possible to enforce a standard format for report, this would be an area to which CIS/TK's research could be applied. In this scenario, an interface between the U.S. central accounting department and all of the local accounting departments in the foreign subsidiaries could be built so that they could transmit their expected exposures on a much more real-time basis for direct consolidation to the ADABAS DBMS. The following are some of the features that would be provided by such a system:

- *Technical format* differences would be resolved so that the data can be automatically integrated. This would not only include file formats, etc. but also transmission protocols.
- *Data representation* issues about which we have spoken above in the CIS/TK review section would also be an important feature of the system. This would most importantly include the resolution of different scaling factors that might be used in the different subsidiaries (*ie.* revenues in thousands as opposed to millions).
- *Data validity* would also be provided at some level. This would take the form of ensuring that, for example, sales are not negative, inter-subsidiary transactions are reported the same "on both sides of the ledger", and that other mathematical truisms hold as they should.

The benefits of the system, or the value that such a system would add to Merck's risk management might be considered to be the following:

- *Fewer human errors* in the input and consolidation process. The extent to which this is a current problem has not yet been ascertained through research, but such a system would surely preclude such problems in the future. Of course, this would have no effect on what is likely the bigger human error problem: exposure forecasting in the local subsidiaries.
- *More frequent consolidation* and analysis of the exposure figures on both a forecast and an actual basis. In such a turbulent macro economic environment, this would likely be of great value. The automated integration would allow this because, as mentioned above, the frequency would not be limited by the speed or accuracy of the manual input process. There would, however, be a question of whether the "other end", that is the local subsidiaries, would be able or willing to provide data on a more-real-time basis.

2.4.1.2 Intelligent Information Retrieval

The amount of news which the risk manager is asked to find, digest, and use is enormous. This is so not only because of the sheer volume of the information, but also because of the multiplicity of potential sources which might contain information relevant to the function. For example, it would be extremely difficult to document all of the potential sources where we might find information relevant to, say, the movement of the Dutch Guilder. While one source may be important at one time, another would be crucial at another. For the risk manager to check all of the potential sources on an ongoing basis would be impossible. To solve this problem, the risk manager like everybody in a similar position, chooses to look at only an abstraction of the available news at any given time. It would be nice to have a system which would "intelligently" search a larger set of information sources available to provide the risk manager with an overall, more accurate picture of what is happening.

While the benefits of such a system would be obvious, the obstacles to building it are just as well-known. CIS/TK research has in fact focused on dealing with many of these same problems and would likely be very applicable in such a system. One of the most obvious areas of such applicability would be the seemingly overwhelming *instance identification* problem. While this has been manifested previously in CIS/TK research as the "GM or General Motors" problem, it is equivalent in kind (though not complexity) to searching news database for news on, say, the french franc and therefore being interested in the occurrence of "French Franc", "FF", "French interest rates", as well as, in some cases, some connection with "Mitterand", "Chirac", "The National Front", etc.

Clearly, such a system would also need to filter out other irrelevant stories as might be presented. In this case, such a filter would need to be able to pass over stories on other "franc-based" countries (Switzerland, Belgium; *etc.*) while also earmarking stories which simply mention "franc" within the context of the French economic situation. While the technology is certainly not yet available to perform such an intelligent search perfectly, CIS/TK research has yielded, and will likely continue to yield, extremely applicable methods for beginning to develop it.

2.4.2 Inter-Source Integration of Data

The ultimate role of the risk manager is, at one level, that of an inter-source integrator. He takes all of the information catalogued in Section 2.3 and integrates it, combining it with his "internal information resource", or experience, to answer the questions laid out at the beginning of that section. In fact, it seemed fairly clear that the Advanced Technology Group

at Merck is very seriously considering the construction of an expert system to model the entire risk management foreign exchange trading process.

• **Create Currency-Specific Databases:** Rather than looking at information on a source-by-source basis, the decision-maker (whether it be a human risk manager or an expert system or a combination of the two) would likely rather look at all of the information on a currency-by-currency basis. That is, using CIS/TK, we might create a "French Franc DB" which would include, as a subset of its contents, the following information: Merck's current franc contracts open (now residing in the MCM information system), current franc exposure (now kept in the Lotus 1-2-3 models as adjusted by the CitiLondon information), current rates available (from Reuters, etc.), different economists' views of the currency (the representation method used for this would be left to the Advanced Technology Group), etc. To create such an series of databases, a CIS/TK-like system would be of great value. For example, it might:

- deal with inconsistencies among rate information sources
- resolve instance identification problems among the sources such as may now exist where the Lotus model refers to the french currency as "FF" while the french subsidiary, seeing no need to draw a similar distinction, might use the prefix "f".
- resolve formatting differences among the sources such as scaling factors used in subsidiary reports, news services, economists, and CitiLondon; and quoting method for exchange rates (while most sources may quote the exchange rate from the point of view of the dollar, the intelligent text retrieval may be finding rates, or predicted rates, that are quoted in terms of the foreign currency).
- discernment of the time profile of the information (i.e. while rates quoted from MCM may be more favorable than those quoted from the banks or Reuters, they are likely not as timely as those available from the latter sources; this situation may also exist for various sources of news as well).end of deletion]

• **Real-Time Monitoring of Currency Proxies:** By maintaining this wealth of real-time currency-based information for every currency in which they do business, Merck would be better able to monitor the movements of the various "hard currencies" (those for which there are active forward markets) with respect to the "soft currencies". This will allow them to go beyond *historical* cross-elasticities and perhaps better predict how various currencies may be related in the *future*. Of course, for this to work, the ATG would need to develop this as a part of the expert system as well.

While it may be difficult to envision a risk management process without including the important personal contact with the economists of the various banks with whom Merck has a strong working relationship, the increased efficiency of the other information sources, particularly that of the intelligent text retrieval, may preclude or at least mitigate the need for this contact.
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2.5 Conclusion

Since the reports from the subsidiary are internal reports, it would be most efficient for Merck to standardize these reports to the same format so as to aid information integration.