

An Analysis of Data Standardization across a Capital Markets/Financial Services Firm

Joan Bader¹, Chris Hayward¹, Jonathan Razo², Stuart Madnick²,
Michael Siegel²

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¹Merrill Lynch

²Sloan School of Management, Massachusetts Institute of Technology.

**MIT Sloan School of Management
50 Memorial Drive
Cambridge, Massachusetts 02142-1347**

Massachusetts Institute of Technology • Sloan School of Management
Cambridge, MA 02139



WORKING PAPER

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² Sloan School of Management, Massachusetts Institute of Technology.

For any questions or comments contact:
Stuart E. Madnick, (smadnick@mit.edu, 617.253.6671), or Michael Siegel (msiegel@mit.edu, 617.253.2937)

1. INTRODUCTION

This paper analyzes the problem of sharing information across and within different hierarchical levels of an organization. In particular, we focus on the impact that particular data structures, as embodied in Information Technology (IT) systems, have on managerial decisions in Capital Markets/Financial Services (CMFS) firms. Our research shows that Senior Management in (but not limited to) CMFS firms continually makes decisions that require aggregation of lower-level information. Depending on the problem, this may require information from a particular business unit or a group of units. Since business units are often separated on the basis of expertise they have developed different guidelines about the data that they produce. More importantly, they tend to develop and manage information primarily for divisional rather than higher-level management purposes. The end result is the existence of a wide array of data structures across the organization. Although in some cases these divisions may capture similar type of information, the different types of data structures are often incompatible and impede the flow and aggregation of information across business units. This results in limited communication across subunits in the firm leading to a partial aggregation of information and inconsistent reports for Senior Management.

The problem of uncoordinated information structures can be better seen in, but is not limited to, the case of critical decisions. For instance, recent financial crises in Russia, Latin American or even in the United States with the big losses in Long Term Capital (LTC) is forcing business units, as it affects many of their operations, to prepare information for Senior Management decision making. This may require a business unit to prepare reports individually or with the cooperation of other units in the organization. However, the problem of uncoordinated data makes it difficult for staff to aggregate all the information from IT systems within or across business units in a consistent manner. This results in reports for Senior Management with partial information only. In those cases when Senior Management ask several units to prepare reports to analyze the situation (because of their expertise) there is also a problem with reconciling difference sets of aggregated data from their multiple non-integrated IT systems. This again results in inconsistent reports from the various units. These inconsistent reports add a layer of complication to managerial decisions, which now have to process the information that they receive before they can actually address the relevant problem. In the end, Senior Management is unable to utilize the information partially aggregated in these reports to its maximum. This is a major management problem that affects all business decisions. It is more pronounced and severe when critical decisions must be made in limited time to preserve the competitiveness and existence of a company.

Our research indicates that the general solution to this problem is to devise data standards that extend (and affect) all divisions within a firm. In other words, data standards that help coordinate the definition, supply, and processing of information that is relevant for business decisions. The benefit of data standards are a reduction in noise and inaccuracy of transmitted information which lead to better informed decisions and improved company performance. However, we recognize that implementing data standards is not an easy task. We thus resort to previous and ongoing research to answer two sets of questions. One set deals with the identification of common impediments to the implementation of data standards. Here we identify both the proper costs of data standards and other non-monetary problems (such as collective resistance to change) that affect implementations. A second set of questions aims at identifying key factors that increase the probability of a successful implementation of data standards.

This paper is organized as follows. In the following section we draw upon previous research that show how firms have addressed this problem of uncoordinated information through the implementation of data standardization initiatives across business functions. However, data standards are not easy to design and implement as the research also indicates. Thus, in Section 3 we review factors and propositions that need to be taken into account to increase the probability of successful implementation of data integration initiatives within their organization. In Section 4 we provide additional evidence that data standards have solved this problem at higher industry and international levels. We look at five examples of data standards and technologies that show how effective they have been in facilitating the process of coordinating the flow of information across subunits. Then, in Section 5 we present the data integration effort of a major CMFS firm that is facing this type of problem and as a result has decided to undertake data integration efforts. We apply the research presented in this paper to evaluate how appropriate their measures are in addressing the problem in question. Furthermore, we provide recommendations that are important for this firm to consider for a successful implementation of these initiatives. Section 6 concludes given the evidence presented in this paper with the proposition that CMFS firms can also coordinate the flow of information across business units to meet their informational needs.

2. BENEFITS OF DATA STANDARDIZATION

Previous research indicates that the problem of CMFS firms of coordinating information across business units can be solved with the implementation of data standardization initiatives. The main conclusion is that the most benefit of a integrated information comes from “the ability to share or aggregate information across many divisions or functions or units of the organization” ([1], p. 300). This evidence is drawn from analyzing the data integration initiatives of 35 large (\$500 million or above) U.S. and Canadian firms ([1], p. 300). Further evidence comes from our ongoing research that indicates that data standards have indeed facilitated the flow of information across subunits. In Section 4 we illustrate our findings with five examples of data standards and technologies. In this section, however, we concentrate on the previous academic research.

IT researchers have found that data integration enables firms to process information across business units accurately and efficiently for the following two reasons. First, data standardization has eliminated additional processing costs and increased ambiguity, as information from the various business units is processed ([1], p. 300). Second, data standardization across business units has improved their operational coordination because they were able to share unambiguous information. In short, the literature concludes that those firms that have undertaken data standardization initiatives across their business units have at least seen the following two major benefits.

Benefit 1: Data standardization improves managerial information across subunits of an organization.

The literature indicates that data integration is necessary for information to serve as a common language for communication about events the organization faces” ([1], p. 300). As in the problem of CMFS firms, research shows that without data integration there are increased processing costs and ambiguity of meaning as information between subunits of the organization is processed. This result in “delays, decreases in communication, reduction in the amount of summarization, and greater distortion of meaning” ([1], p. 300). Firms that have undertaken data integration initiatives, that is, the standardization of data definitions and structures for use across different parts of an organization have eliminated these problems. This is because “data integration facilitates the collection, comparison, and aggregation of data from various parts of the organization, and more importantly, leading to better understanding and decision making when there are complex, interdependent problems” ([1], pp. 300-301).

Benefit 2: Data standardization improves coordination across subunits of an organization.

Another major benefit that comes from standardizing data within a firm is that business functions were able, not only to share information accurately and efficiently between them, but also to coordinate their actions. Furthermore, this sharing of standardized information across business units enabled some firms to identify unperceived interdependencies between functions. As a result, firms have leveraged this flow of accurate information and unperceived interdependencies between their subunits to improve their operations ([1], p. 300).

More evidence comes from ongoing research on data standards developed at the industry level. Although these data standards have been developed for the use of firms and not business functions, there exists a parallel in the fact that firms act as subunits in an industry and they need to coordinate the flow of information between them. In section 4, we see how firms have seen these benefits presented in this section.

In sum, research indicates that the data aggregation problems of CMFS firms can be solved with data standardization within their organization. We have seen in this section how firms that have undertaken data standardization initiatives have found a way of coordinating and processing accurate information across its subunits. This data integration has lead to improved and better decision-making of the organization. However, we also recognize that implementing standards is not an easy task. In the following section we present a set of factors and lessons that we have identified in the literature that are important to consider for successful implementation of data standardization initiatives within a firm.

3. FACTORS AND PROPOSITIONS IN DATA STANDARDIZATION

As previously highlighted, data standardization is not an easy task. In this section, we review additional related research to answer two sets of questions. First, we are interested on identifying losses and costs, and other non-monetary factors that affect the implementation of data standards. Second, we want to identify lessons (i.e. propositions) for the implementation of data standards. CMFS firms need to take these factors and propositions into account in order to increase the probability of a successful implementation of data standards across their business units.

3.1 Factors

Factor 1: Losses in flexibility to Meet Unique Business Units Needs

Data integration affects the flexibility of business units within an organization to meet their unique needs when they face changes in their environments. Research indicates that various part of the organizations that have integrated IT systems might not always meet the local needs as effectively as separately designed local IT systems. This is because local autonomy in the design and use of data is lost since data standardization implies “some degree of logical centralization and some central authority with control over the logical aspects of data”([1], p. 302). Furthermore, research also shows that even when business units have agreed on standardizing data, bureaucratic delays reduce their local flexibility to make changes. This requires that all business units involved analyze how changes to the data standards may affect their own operations. If they do not agree, then changes to the data standard cannot be made. The reason why they may not agree is that the proposed data standard imposes constraints on the way they can respond to their unique needs in the future. In short, research shows that data integration is more effective when needs of units are homogeneous across the organization. This is because subunits can avoid incurring additional cost in compromising their heterogeneous needs, and reducing bureaucratic delays, and more importantly, meeting both local and global needs beyond the realm of business units ([2], p. 303).

Factor 2: Design and Implementation Costs of Data Standardization Initiatives

The cost of designing and implementing data standards is another critical factor that needs to be taken into account even when the perceived gains might outweigh the losses. Research indicates that “as the number and heterogeneity of business units increases, the difficulty of arriving at acceptable design compromises increases, and the cost of the resulting design will increase more than linearly”([1], p. 304). In addition to these up-front costs, firms incur long-term costs as they make changes to IT systems because it affects their flexibility to meet future needs. The literature shows two important conditions that can help firms decide whether or not their initiatives will be successful. First, firms with many homogenous business units can achieve additional benefits because their lower long-term costs offset the higher up-costs incurred of designing and implementing data standards. This benefit can be achieved because a single change in a data standard uniformly addresses all future needs of business units. Second, those firms with many heterogeneous business units may be less likely to integrate extensively because the gains achieved with data standards do not offset the future costs involved when they need to make changes to their data standards. What this indicates is a trade-off in gains and costs that depend crucially on the homogeneity, or lack thereof, of business units. This is not to say that heterogeneity alone will make an initiative unworthy of implementation. It is to say, however, that implementation costs will increase with heterogeneity. A proper management of differences across business units can help mitigate the losses and, when all other factors are considered, lead to net gains in the implementation of a data standard.

Factor 3: Non-monetary Factors that have an impact on Data Standardization Initiatives

In addition to losses and costs, there are other non-monetary factors that might affect how firms implement their data standards. IT research has recognized that the structure, strategy, individual roles, and management processes are all tightly interdependent in organizations ([1], p. 306). This means that none of these elements can be changed without having an impact on the other. As a result, firms need to analyze how data standards affect each of these elements. This research indicates that those data integration that succeed do so because of two major reasons. First, business requirements drive these data integration efforts. Secondly, Senior Management clearly sees these efforts as critical to the strategy of the firms and champions them ([1], p. 306). We have also seen that even when data standardization leads to large benefits to the entire organization, power and politics may cause these efforts to fail

([1], p. 307). This is because benefits may be distributed unevenly across the organization and business units and parties resist the implementation of these efforts if they see their roles and power affected. In short, it is important for CMFS firms to understand how their initiatives affect the structure, strategy, individual roles and management processes.

3.2 Propositions

Fortunately, we are able to draw upon previous research to obtain lessons about how to overcome impediments to a successful data initiative. Although many of these lessons are drawn from studying Strategic Data Planning¹ (SDP) they are instructive because they deal explicitly with factors that affect the probability of success of data integration efforts. Since this methodology can be applied to achieve different level of data integration across the firm, these lesson are grouped into four major categories. The first two sets of propositions deal with full and partial integration of data across the firm, respectively. The third set of propositions emphasizes that is important for firms to clearly understand the implications for reaching goals that their chosen approach to standardize data may produce. Lastly, the fourth set provides two propositions that indicate why the benefit of promoting education and communications across the organization is not necessarily a byproduct of data integration efforts.

Implementation of completely integrated systems

Using SDP involves the elaboration of a detailed plan that would lead the implementation of integrated systems. It may require rewriting (or writing for the first time) all systems ([2], p. 14). This is a major task and required that firms have a good understanding of its implications. For those firms that “are not prepared to undertake the cost of such a massive rewrite effort...SDP involves them in an expensive process that may not be necessary” ([2], p. 22). The following lessons are drawn from analyzing those failed attempts.

- *Proposition 1: SDP is a design methodology, as well as a planning methodology.* This implies that all IT systems in the organization are being redesigned, and actually starts the process of IT system design. As the research indicates, this is appropriate only when it is true that all systems will be redesigned. Those firms that had this intended goal and were prepare to undertake the cost were successful in implementation integrated systems. ([2], p. 22). On the other hand, those organizations that failed to understand these implications saw much of their effort go only into the initial design of systems that were never built.
- *Proposition 2: Top management must perceive data integration as critical to the strategic goals of the organization.* As previously presented, non-monetary factors can affect the implementation of data standardization efforts. The evidence of those firms that failed indicates that Senior Management did not recognize these efforts as critical to the success of their business strategy ([1], p. 306). Senior management were only involved in the planning stage allocating individuals and money, however when the true costs of the data integration initiatives became apparent or when other business issues diverted their attention, their involvement evaporated ([2], pp. 23-24).
- *Proposition 3: Data standardization efforts require sufficient control over the planning domain.* As we showed in the factors above, data integration may impose loses or costs to business units or individual as they lose autonomy and flexibility to meet their unique needs. Those firms that lacked a mechanism to reach consensus, such as a centralized authority or negotiated consensus to resolve conflicts, on the tough issues that affected some could not implement their data integration efforts successfully ([2], p. 24).
- *Proposition 4: Efforts to implement data integration need to balance global integration and local flexibility.* Since data integration implies a loss to business units of local flexibility and involves up-front implementation costs, it requires the support of key stakeholders in these units (divisional support) and higher-level support as shown in proposition 2. In addition to the support, “data integration efforts may need to find the right balance between the value of global data integration versus local flexibility”([2], p. 24). Those firms that could not gain the support of key people in the different levels of the organization could not integrate data beyond their current

¹ SDP is a “formalized, top-down, data approach that builds a model of the enterprise, its functions, its processes, and its underlying data as a basis for identifying and implementing an integrated set of information systems that will meet the needs of the business”([2], p. 12).

level of data integration. This was because “the additional value of more global data integration was not compelling to the decentralized divisions” ([2], p. 24).

Creating a data standards that lead to gradual integration

The following lessons come from analyzing those firms that were unable or unwilling to revise all their systems in the near term. Their approach was to use SDP to create data architectures that would help them gradually move toward a set of integrated IT systems as new applications are built and old IT systems revised. It is important to note that the narrower scope of this approach was not the reason why firms had difficulties in creating these data architectures. They ran into problems because the following implications were not considered or well understood:

- *Proposition 5: Data architectures are not easily created.* The research shows that some firms have difficulties deciding what form of data architecture they need to achieve their data integration goal. Firms have developed data structures taking different forms, some more complex than others, that do not provide them with valuable guidance to design their systems. Firms need to understand their own organizational circumstances. This understanding can assist them to identify their information needs and as a result create more effective data architecture to design systems to meet their needs ([2], p. 24).
- *Proposition 6: Alternative approaches should be considered for developing an integrated architecture.* As seen, there are many costs associated with the design and implementation of integrated IT systems. Some firms failed to compare other alternatives to arrive to the same level of integration ([2], p. 25). To that effect, firms should explore all their potential options to design architectures to see if they can achieve the same goal of integrating data less expensively.
- *Proposition 7: Data integration teams are more likely to run into problems if their scope of data integration is too large.* As we show in proposition 1, SDP requires rewriting and redesigning of all systems. This implies that firms must undertake a great level of detail in the planning phase. As a result some firms were unable to develop their IT systems because planners in this type of situation got “lost in the crush of detail” ([2], p. 25). In order to avoid this outcome, it is important for firms to restrict their analysis to the level for which they can have full control. This will enable data integration analysts to produce their desired architectures.
- *Proposition 8: Architectures must be enforced in order to have an effect on data integration.* Since data standardization affects business units and individuals, sufficient control in the planning domain is needed as shown in proposition 3 to enforce data integration efforts. The research indicates that those firms that could not enforce their data structures also failed in achieving their goals of data integration because key stakeholders refused to conform to these structures ([2], p. 25).
- *Proposition 9: Imitation is an efficient way of devising architectures rather than reinventing them.* The principle of information engineering suggests that firms should imitate and avoid reinventing structures. This is based on the following claim found in the literature: “To the effect data architectures are stable over time within a company, they should also be quite similar across companies within an industry” ([2], p. 25). Thus, instead of incurring the cost and time requirements of designing architectures, firms can benefit from imitating other data structures that can enable them to meet their information needs. Furthermore, this approach may produce better architectures because additional time and experience will have refined the re-used items.
- *Proposition 10: Do not spend too much time bringing novice data modelers up to the learning curve.* Methodologies such as SDP require that individuals spend substantial portions of time of planning time developing a model to use as a basis for the data architectures. As observed in those firms that were unsuccessful in their integration efforts, members who are not expert data modelers generally are the ones doing the modeling. Although the modeling experience provided useful knowledge to participants, it was not the best efficient way of developing a data structure. Not only it was inefficient, but also resulted in data structures of uneven or less than the desired quality. Firms might be better off if they select team members with experience in data modeling and who can commit to this task.

Identifying systems priorities

The previous sets of propositions are lessons from analyzing efforts of totally integrated systems and data in either the short- or long-term. The following lessons come from analyzing those firms that wanted to identify potential systems to implement in the near future. Research shows that for firms that failed to achieve this goal, their methodology was not the most appropriate to identify their priorities. Thus, it is important to understand and assess to what extent a methodology can assist firms in achieving their goal of integrated data.

- *Proposition 11: For a system priorities goal, SDP does not narrow its scope fast enough before it begins the time consuming process of modeling business functions and entities.* The literature indicates that if firms want to identify high payoff projects, then “the more quickly attention can be focused on those systems or functions that have a critical business impact, the sooner that impact will be evident in the organization’s competitive position or bottom line” ([2], p. 26). However, those firms that failed to achieve this goal found that SDP was not the most appropriate methodology. This is because SDP gives each function and each entity equal weight, resulting in detailed modeling of systems that will not be built. Thus, this proposition re-emphasizes proposition 6 that firms should explore other approaches that are more appropriate to meet their intended goals and levels of data integration.
- *Proposition 12: The volume of detail swamps creativity.* Proposition 7 illustrates how large scope may affect the performance of planners. Firms that used methodologies that required a significant level of detail did not realize that this volume of detail affected “individuals’ ability to see the whole picture and fashion creative solution” ([2], p. 26). As a result, these firms were unable to develop systems that added value to the organization. Therefore, as seen in previous propositions, not all methodologies lead to the desired result and firms need to assess how appropriate they are to meeting their goals.
- *Proposition 13: Individuals’ time requirements may add as a screening device that selects less desirable participants.* Proposition 10 shows that in cases when firms fell short of achieving their desired level of integration, it was because the right members might not always be included in the data integration team. The research indicates that this happens because the time of the most capable (and insightful) individuals is usually in high demand to attend other business issues. To avoid this outcome, it is important for firms and key stakeholders (as proposition 2 indicates) to clearly understand how critical these initiatives are to the overall performance of the firm. This will ensure that firms will assign and commit the most qualified candidates that can produce much better models and systems.

Promoting education and communication

The last set of propositions shows how team members, in spite of implementing data standards that met their firms’ needs, had problems communicating and educating the organization of the value of these efforts.

- *Proposition 14: New knowledge about the purpose of data integration initiatives is difficult to be diffused within the organization.* The literature shows that organizational learning is not always a by-product of data integration effort ([2], p.27). In some cases, members in charge of data integration efforts reported having a great difficulty convincing the organization, including top management about the importance of data standardization ([2], p. 27). This shows “the importance of an organizational learning analysis during the planning process to assess how new technologies will be accepted and institutionalized throughout the firm” ([2], p. 27).
- *Proposition 15: Education and communications alone can probably not justify the cost of a data integration effort.* Since there are costs involved with data standardization efforts, in some cases firms found that education and communication were not sufficient to justify the high cost of this methodology. This suggests that organizations need to explore all their different approaches to standardize data (proposition 7) because there might be other less expensive approaches to achieve the same goal. In addition, they need to undertake an organization learning analysis (proposition 14), to see what combination of benefits may result from standardizing data. The research indicates that those firms that found ways to show all the benefits that come from standardizing data had a much easier task educating the organization and, more importantly, justifying the cost of their data integration efforts. ([2], p. 27).

In sum, it is important to understand that there are factors that affect implementation of data standards across the different business units of an organization. It is also important to fully understand the goals and desired level of data standardization. These lessons, if taken into account, can assist firms to develop successful standards using the appropriate approach or methodology. The following provides examples of data standards that illustrate how they facilitate the flow of information and also show how some lessons presented in this section have contributed to their adoption.

4. EXAMPLES OF DATA STANDARDS EFFORTS

As seen in Section 2, research shows that many firms, in addition to CMFS firms, have faced the same type of problems in coordinating the flow of information across their business units and they have solved them with the implementation of data standardization initiatives. In this section we present additional evidence that data standards can enable the flow of information across business units. Although the following five examples of data standards presented in this section have been developed at the industry level for the use of firms, there exists a parallel with the problems presented throughout this paper. Similarly to the relationship of business units in an organization, firms act as individual units as they interact with other firms and need to coordinate the flow of information that exists among them. The following examples show how data standards (and technologies) have facilitated this coordination of information and provide lessons for their widely accepted use across firms and industries. The first three standards have been adopted primarily in non-CMFS industries while the last two examples of standards have been particular developed for the CMFS industry.

4.1 Data Standardization Initiatives in non-CMFS industries

Electronic Data Interchange

Firms in different industries have experienced problems collecting, aggregating and sharing information accurately with their business units and trading partners because the information they share is not standardized. As a result, firms spend large amounts of time and money to reconcile differences and errors from the information that they share within their trading partners. For example, organizations but not limited to the Grocery, Transportation, Warehouse, Agricultural, Telecommunications, and Manufacturing industries have turned to the use of the Electronic Data Interchange (EDI) standards to solve this uncoordinated problem of information. EDI is a computer to computer exchange of business information between companies, using a standardized messaging format. In our research we have seen organizations (or entire industries) agreed on a set of fields of data and developed messaging formats. As a result, organizations use these standardized messaging formats to transmit information accurately. A typical transmission requires the sender to generate a transaction into the previously agreed EDI standardized messaging format. At the receiving end, the information is then translated using the same messaging format and entered into the receiver's systems. This information is more accurate because these standardized messaging formats also includes extensive data editing and error-checking routines at the transmission stage.

Our research indicates that those organizations using EDI messaging standards are achieving gains in the following areas. First, they no longer need to incur additional costs in reconciling differences and errors from the information they exchange. Second, since this transmission is electronically, many firms have realized substantial productivity improvements in eliminated the great volume of business paperwork and many of the clerical tasks involved in handling the processing of paper documents. We make two observations that explain why EDI has become a standard in many industries. First, implementing EDI solved the problems of firms in sharing information accurately and efficiently. More importantly, staff can now aggregate this information and produce accurate reports that are critical to measure the performance of their firms. Second, organizations with significant bargaining power over its trading partners are enforcing its adoption. For example, the US Federal government requires that its suppliers and vendors transmit their invoicing information using EDI in order to get paid and we have seen these suppliers adopting EDI messaging standard. As seen in the previous section (proposition 8), enforcing standards is important to ensure its successful implementation and adoption.

Consumer Product Barcoding

The consumer product industry faced the problem of collecting accurate product information because one or more products were assigned the same number. This problem hindered the ability of both manufacturers and retailers to manage their supply chain and inventory levels more efficiently. Furthermore, they were unable to measure how successful their products or marketing program have been in the market. These problems led the consumer product industry to develop the Unified Product Code (UPC). This code or barcode is basically divided into two halves. The first half identifies the manufacturers with a manufacturer number assignment coordinated through the Uniform Code Council. The second half is left up totally to the manufacturer to identify a product. As can be seen in the consumer industry, this barcode has become a standard. This is because nearly every item sold today can be identified with a unique barcode. In addition to solving the problem of accuracy, its adoption has been facilitated because both manufacturers and retailers see the following benefits. They can aggregate accurate information for better decision making and have seen operational gains in managing supply chains and inventory levels more efficiently. Since barcodes are scanned, this information can be sent directly to IT systems of both retailers and manufacturers eliminating past problems of human entry errors. In addition to the benefits, we have identified the following observation for the successful adoption of the barcode. The standards helped the industry to meet the objective of unique product identification, but also imposed minimal standardization upon the manufacturers. Their flexibility to assign the second half of the barcode to meet their own unique needs facilitated their willingness to adopt it as a standard. This is important because as we saw in the previous section, data integration efforts need to balance both global integration and local flexibility (proposition 4).

DUNS Number

Our research indicates that some firms that need to aggregate information about their clients need to have a common client (or party) identifier. This is for two reasons. First a client may be a large organization consisting of multiple units (i.e. divisions, subsidiaries or branches) and each of them may enter into a business relationship with an organization independently of the other. If this is the case, then those organizations that need to know the aggregate value (of all these transactions with a given client) need to add all the transactions that took place with all the subunits of this client. However, aggregating this information is difficult because this requires that firms create and maintain a corporate hierarchy for each of their clients. Furthermore, information about transactions may be captured in many systems that use a different scheme to identify their clients. Since creating and maintaining involves also standardizing these clients identifiers, some companies have found the task costly and difficult to accomplish, and have turned to third-party solutions such as a DUNS Number. Dun & Bradstreet is an organization that has expertise in creating and maintaining corporate hierarchies. It assigns a unique DUNS Number to each parent, division, subsidiary, headquarters within an organization. These unique numbers are then linked to create a corporate hierarchy relationships that can facilitate the unique identification of each member of the corporate hierarchy. As a result, firms that have adopted using DUNS Number in their systems and to maintain corporate hierarchies are not only able to aggregate information about their clients, but also are forcing their clients to adopt this number as a common identifier for their EDI and other electronic commerce transactions. In short, we have identified the following two lessons. Our first observation is that all data standards do not have to be developed internally (proposition 9). A third party solutions such as DUNS Number can minimize the design and implementation costs involved with data standards (factor 3). Second, firms with significant power over their trading parties (such as in the case of EDI) are requiring their clients to adopt this identifier. As we saw in the previous section (proposition 8), data integration initiatives need to be enforced. This, in fact, was a key reason for the adoption of DUNS Number as a EDI identifier across several Departments in the U.S. Federal Government, United Nations (UN EDIFACT Council), European Commission, and International Standards Organization (ISO). It is also recommended and requested over other major industries (such as the Aerospace, Automobile, Chemical, Baking, Telecommunications, Textiles to name a few) involved in electronic commerce and EDI transaction with suppliers and vendors firms.

4.2 Data Standardization Initiatives in CMFS industries

CUSIP Number

In the late 1960s the lack of a unique number to identify securities in the Financial Services industry hindered the accurate and efficient clearance of securities. In 1967 the Committee on Uniform Securities Identification

Procedures (CUSIP) Service Bureau was created to study this problem and assist this industry in identifying securities with a standardized number. Upon analyzing the problem, the committee recommended the development of the CUSIP number. However, in order to ensure successful adoption of this unique identifier, they realized that it would require the participation, cooperation and support of the entire financial industry. In fact, since its development all major segments of the financial industry understood the importance and impact of this number to meet their unique needs as well as those of the entire industry. To that effect, this industry has adopted this number as the standard identifier to uniquely identify over 4 million securities. More importantly, this standard has enabled the accurate and efficient clearance of securities, and thus solved this problem in this industry.

SWIFT Messaging Standards

In addition to identifying securities with a unique number, CMFS firms need to exchange financial information with other players in this industry. To that effect, since 1973 the Society for Worldwide Interbank Financial Telecommunications (SWIFT) has developed messaging formats that facilitate the exchange of financial data worldwide securely, cost effectively and reliably through its global network. Our research indicates that financial institutions in this industry have clearly understood the importance of coordinating information for the overall efficiency of the industry and are adopting these messaging formats. Furthermore, another reason why these messaging formats are becoming standards in this industry is because organizations see value added in using SWIFT's global network. This global network enables firms to exchange information more cost effectively than using other media. However, SWIFT enforces a rule that information can be only be transmitted to this network using the messaging standard it has and continues to develop. As a result, firms are complying and using these messaging formats to meet their needs. Thus, today, over 6400 financial institutions in 177 countries use SWIFT's standards. The growth in the use of these messaging format has grown over 800 million messages with an average daily value of transactions estimated to be above 2 trillion of U.S. dollars that is carried through its global network. In short, we have identified the following two lessons from analyzing this standard. First, similarly as we saw in EDI, the use of these messaging formats enables firms to meet their need of coordinating information with other firms more efficiently. Second, as we have seen in the previous examples, enforcing a standard is important for firms to conform to ensure its successful adoptions across firms.

In summary, we have seen five examples that have been developed to solve informational problems within entire industries. As we see through analyzing these standards, as well as the academic research presented in the previous section, there is a set of factors and lessons that can provide CMFS with critical insight about the organizational requirements of data standards. We present in the next section a case study of a major player in the CMFS firm that is in the process of designing and implementing data standards. Their purpose is to facilitate the flow of information across its multiple IT systems in various part of the organization.

5. CASE STUDY: MERRILL LYNCH

We have seen that firms that have a need to coordinate information across business units or with other firms have benefited from data standardization. Merrill Lynch (ML), a major player in the CMFS industry, has problems coordinating information across business functions. In order to solve this problem, Merrill Lynch has launched a data integration effort. We focus on two of its major efforts, the Party Repository Initiative (PRI) and the CFO Committee on Data Entity Definitions. We conclude this section with an evaluation of these efforts,

5.1 Data Standardization Initiatives

Party Repository Initiative (PRI)

As we have seen in the structure of many organizations, business functions are often divided by their expertise. ML is no exception and for this reason business functions have designed systems that only meet their divisional needs. However, changes in the environment, such as globalization and increased competition in this industry is forcing ML to coordinate information across functions in order to assess how changes affect its overall performance. One of the problem ML faces is how to coordinate information of parties (i.e. clients) across all functions and IT systems. This has been a critical problem because each function had designed systems with different types of data structures that capture party information differently. This inconsistency of data structures has hindered the ability of ML to

identify parties with a unique identifier and name, create company hierarchies (as we saw in the example of DUNS Number), and aggregate information for senior reporting to monitor exposures associated with these parties. In order to solve the problem of uncoordinated data structures, ML has launched the Party Repository Initiative (PRI). This initiative has two major components. First, the development and implementation of a unique identifier that will be used across all business units and provide the functionality to prepare reports for management decision making. ML expects that this identifier will prevent the duplication of party identification names and numbers and, upon completion, all IT systems across the organization must access this repository to obtain the unique party identifier. Second, PRI is expected to provide the ability to maintain the corporate hierarchies structures of all parties. These hierarchies will facilitate the aggregation of information of parties. Furthermore, PRI design and implementation consist of two pilot phases to analyze several of its businesses, and to learn about new business and technical issues that can be leveraged in future releases of PRI. The first phase of this initiative is to create the repository. Phase two involves the connectivity of PRI to all systems participating in the pilot effort. At the time of our research, the PRI team consisted of IT business managers and developers representing various parts of the organization that will be using PRI. Our assessment at the end of this section is based on our observations at this stage where this team was modeling and discussing the design and implementation of this repository.

CFO Committee on Data Entity Definitions Initiative (CFO Committee)

The propagation of uncoordinated data structures across ML systems has hindered the process of data aggregation for Senior Management reporting. Since there are many data structures across the organization, the CFO Data Entity Definitions Committee (CFO Committee) was put together and assigned the following major tasks. First, this multi-functional committee is in charge of identifying and defining those key data structures that are important at the corporate level and that will be communicated to the different business units for corporate reporting. Second, in order to implement these data structures, the committee needs to identify and design a data architecture. Upon completing these tasks, the committee will communicate these definitions to business functions that need to adopt these data structures in their systems. ML anticipates that these standardized data structures will facilitate Senior Management reporting. The committee organized several workshops to identify and define data structures that will be standardized. In each workshop, the committee has taken the following approach to achieve this goal. First, the committee has analyzed what other previous and ongoing data integration initiatives such as PRI. Second, since the committee represents those functions that will be using these standards, they analyzed business units unique needs and compromised when it was seen appropriate in including their needs as part of level of detail that each data structure will capture. Third, the committee has hired consultants from a major consulting firm to guide them through the process of defining data standards. Lastly, some members of the committee have worked, and continue to work, with faculty from the Sloan School of Management of the Massachusetts Institute of Technology. These faculty members have been chosen for their expertise and research on data integration efforts.

5.2. Observations from study of ML Data Standardization Initiatives

In this paper we have studied the literature regarding Data Standardization as well as the current activities underway within Merrill Lynch (ML). We evaluate ML's effort in comparison with other case studies. In this section, we make brief references to similar situations encountered in the literature; for more details on these examples, the reader is referred to [1] and [2]. Likewise, we identify those areas that ML has not yet considered, but which are important for a successful implementation of data standards within a firm.

Observations of what ML has done well in its Data Standardization Initiatives

We have identified the following key factors from working with ML staff involved in these data standardization initiatives. We describe the benefits that these factors may entail upon completion of the two initiatives:

1. *The CFO Committee's "partial integration" approach.* The CFO Committee has limited its scope to standardizing a minimum set of data entities. It deliberately selected a "partial integration" approach rather than undertaking a "full data integration" approach of defining and integrating all of the firm's data entities. We have observed firms that have undertaken the latter approach have run into trouble (*Proposition 7*). For instance, the committee of data standards at Cedar Industries² was involved in a data standardization initiative, whose

² All company names have been disguised (for more details see [1], p. 294).

purpose was to create a division-wide data architecture and to identify and prioritize future systems development projects. They adopted a full integration approach, which greatly diminished their ability to successfully implement the initiative. This was so because they were involved in developing a very detailed data planning model that did not concentrate on any division's number one problem, but it ended up surfacing everyone's second priority problems, and was very time consuming and expensive ([2], p. 21). It is thus anticipated that "partial integration" will benefit ML in the following ways:

- Take advantage of the *immediate value* that comes from identifying and defining those data entities that create interdependencies between its functions (*Benefits of Data Integration & Proposition 11*);
- *Cost savings*, an additional advantage, which is readily observable because partial integration requires less resources, both in time and money (*Factor 2*);
- *And learning curve benefits*. This knowledge can be leveraged for more extensive future integration initiatives (*Proposition 9*).

2. *Prioritizing data standardization for critical areas that add value to the organization.* Selective data standardization aimed at critical data entities can add value to the organization. Goodhue and Rockart have observed that the quicker an organization focuses its attention to those "systems or functions that have a critical business impact, the sooner the impact will be evident in the organization's competitive position or bottom line" ([2], p. 26). The goal is to prioritize the minimum set of high priority elements to be standardized. There may be a desire as part of the exercise to over standardize elements thinking it will be easy, but this could be a serious mistake. ML understands that there are entailed benefits in pursuing a partial integration approach that places different criteria on data entity definitions, depending on how critical these are to the organization. The goal is to select a minimum set of high priority items to be standardized and thus avoid the temptation to over standardize. Therefore, to add the most value to the organization, the CFO committee has concentrated on global data items such as "Party", "Country", "Instrument" that are used globally across ML IT systems. The benefits of ML's selective approach can be validated with reference to other cases. For instance, Burton Trucking Company (BTC) overhauled its IT systems based on standardizing data for the entire organization and, as a result, they were able to link data not only across geography but also across functions. In the case of ML, once data standardization has been prioritized, and critical areas identified, the data entities that have been designed can be used throughout the entire organization. For example, the creation of the Party Repository Initiative (PRI), a global warehouse of Party information will improve how different functions share data between themselves. Therefore, ML can capitalize from this benefit of data linkage across its functions in several ways (*Benefits of Data Integration*):

- Produce critical reports with more accurate measurement of ML's exposures for Senior Management (*Proposition 2*);
- And analyze these exposures by different dimensions (i.e. geography, instrument, type of exposures, etc.), which currently has been very difficult for them to do without data standards.

3. *Cross-functional teams facilitate identification of functions' unique needs (Factor 2).* The CFO Committee, a cross-functional team has facilitated the identification of specific functions' needs. Thus, upon completion, the CFO Committee will communicate its definitions of key data elements to ML's various lines of business for corporate reporting purposes. Since these functions are the end users of these data elements, it is important that the definitions they are provided are applicable to their businesses and strategies. The CFO Committee is comprised of members of several functions. They have sought to understand the unique needs of different functions as they analyze and compromise on common definitions for firm-wide use (*Factor 1*). The particular benefits from this approach are to provide ML with the ability to:

- Leverage the knowledge of members about their specific functions' needs (*Proposition 10*);
- Consider their critical needs and take them into account in the data standardization process (*Factor 1*);
- And, thus, achieve a balance between global integration and functional specific needs (*Proposition 4*).

4. *CFO Committee is leveraging ongoing data standardization initiatives.* It is important to leverage from the learning of other ongoing data standardization initiatives. Goodhue's research on data standardization argues that organizations should leverage from other data initiatives and should avoid reinventing it (*Proposition 9*). For example, Waverly Chemical first developed a data model for one of its divisions. Later, when another division decided to go through a similar data standardization initiative, after observing the first division's success, they were able to refer to the original model. With minor changes, this new team was able to successfully adopt the original model for the second division. There is indication that the revised model, now used by both divisions, is of superior quality ([2], p. 25). In the case of ML, the CFO Committee has also

followed a strategy of leveraging from previous or other ongoing initiatives. For, example, when defining the data entity "Party", this committee looked at what PRI has done and made minor changes to the work the PRI team had previously performed. Furthermore, ML plans on leveraging the capabilities of an external structure system, Dun & Bradstreet DUNS Number providing parties identification numbers, legal names and hierarchies (i.e. parent company and its subsidiaries). Thus, ML can avoid the time consuming task and additional cost of designing and developing internally this system from scratch but benefit from the cost savings that can come with leveraging from DUNS numbers (*Factor 3*). In sum, there are three advantages to this approach:

- The CFO Committee is leveraging the work done by the PRI team (*Proposition 9*);
- This task required less cost requirements (*Factor 1*);
- And, they are reducing the amount of time that it would have taken them to start from a clean slate.

5. *Partnering with Academia and learning from the experiences of other industries' data integration initiatives.* The CFO Committee has been consulting with the Faculty from the Sloan School of Management at the Massachusetts Institute of Technology (MIT Sloan School of Management). As mentioned early, these faculty members have been chosen for their expertise and research on the establishment of data standards across organizations. This partnership provides the following valuable benefits:

- ML can gain valuable feedback about how well they are approaching their data standardization initiatives;
- ML can avoid some of the obstacles that other organizations have faced to have successful initiatives and avoid some of the costs those organizations incurred (*Factor 2*);
- And, ML can learn from those organizations' initiatives that have been successful in implementing data standards and replicate a similar strategy instead of reinventing it (*Proposition 9*).
- ML must be alert to not attempt to over-standardize or over-solve the problem but must relate the effort to practical business value (*Proposition 7*).

Recommendations to enhance ML Data Standardization Initiatives

We have also identified the following areas that ML needs to take also into consideration for a successful implementation of its data integration initiatives.

1. *Need for Analyzing the Implementation and Organizational Impact of ML Data Standardization Initiatives.* As noted in Section 3 of this paper (*Other Non-Monetary Factors*), Data Integration improves transparency across organizations, influences the roles and rewards systems of individuals, and may have an uneven distribution of benefits among subunits. These factors may influence certain functions and individuals to resist implementation of a data standard. In addition, even the possibility of changes in the power balance can cause resistance to implementing a data standard by those concerned they might lose out ([1], p. 307). Since these factors are critical for a successful data standardization initiative, they ought to be considered as ML moves into its implementation phase. Research in other industries has found that ignoring these issues is detrimental to the success of data standardization initiatives. For instance, consider the case study of Spectrum. The Vice President (VP) of Manufacturing, the VP of Materials, and the director of IT lobbied and positioned themselves to move to a single set of integrated databases and common IT systems to be used by all the plants. A few plant managers resisted so strongly that only their early retirements allowed this data integration team to proceed ([1], p. 307). We have observed that at this point ML is concentrating on its phase of identifying and defining key data entities and developing PRI. However, the impact that these data standardization initiatives will have on the organization has not yet been considered. To that effect, we make the following recommendations.

- Should perform scenario analysis or pilot efforts that can provide the CFO Committee and PRI with important feedback early in this process about whether or not their data standardization effort are more likely to run into obstacles and plan ahead to minimize them (*Other Non-Monetary Factors*);
- It is important to identify the differential impact that an initiative will have across functions. This is important because with any initiative not only can different functions obtain different benefits, but also some functions may result as net losers from the initiative. The support of functions that are affected negatively, or otherwise obtain less benefit than others, is crucial for the initiative to be successfully completed.
- There needs to be a mechanism to mitigate real issues and provide for interim solutions that would preclude moving to a standard later. It also should be possible to allow for a small number of co-existing standards that may, in time, evolve toward a single standard (e.g., debt and equity to each have a standard as a migration to a single standard, with the thought that two is far better than 30).

2. *Improve Senior Management Buy-in and Involvement with ML's Data Standardization Initiatives.* If Data Standardization Initiatives are to be successful, then Senior Management must be perceived it as being critical to the organization's strategic goals (*Proposition 2*). We know that ML Senior Management is aware of the PRI and CFO Committee initiatives. However, as Goodhue emphasized from looking at several companies' data standardization initiatives that to be successful, an organization must involve its Senior Management in the process. He argues that "it is not sufficient to enlist top management involvement, if involvement simply means approval to engage in the planning effort, and allocating individual and money to that end" ([2], p. 24). He makes this observation because out of nine companies he analyzed, only one, Ventura Support and Service Division (Ventura SSD) was successful in implementing its data initiatives because its Senior Management understood well that data sharing between systems was critical to the success of their business strategy. This result does not mean that in the other eight companies Senior Management was not involved. They were involved enough in all the cases to fund the planning project (about half a million each) and to give at least nominal support ([2], p. 22). However, Senior Management failed to see how critical these data sharing initiatives were to the success of their organizations. We have observed that those data integration efforts that succeed "are those driven by business requirements clearly understood and championed by top management" ([1], p. 306). Thus, it is important for ML Data Standardization Initiative staff to:
 - Educate and communicate effectively why it is important undertaking these initiatives;
 - Improve Senior Management buy-in and involvement with data initiatives (*Proposition 2*). This approach will help ML avoid following the same fate of some organization that failed to involve its Senior Management and consequently had a great difficulty convincing others why they should use the data standards, including Senior Management (*Proposition 14*);
 - And, help Senior Management recognize the critical importance of their role in the success.
3. *Enforcement of Data Standards is critical to have an effect on data integration:* Our research indicates that companies often have enforcement problems even after completion of their data standards. For example, Ventura faced opposition from systems developers that decided against conforming to the standard ([2], p. 25). However, we have also seen organizations that have been able to make their standards very desirable to its users and as a result they get user's buy in without resistance. For example, SWIFT is a private standard that organizations are using to share information with each other. The way SWIFT gets buy-in from its users is that it requires all its users of its lines to use SWIFT's messaging standard over its communication lines. Since organizations see valued added in using SWIFT's lines, they conform to using SWIFT's messaging standard. We recommend for ML to find ways to:
 - Enforce their data standards through innovative incentives, penalties, and other means (*Proposition 8*). This is an areas where Senior Management can play a critical role as we explained previously how important is for them to see Data Standards as part of their business strategies and get involved in the process;
 - Another way is to make ML's data standards and operations very desirable. ML can do this by showing the added value to functions that they would get if they use the data standards. As a result, if users see this value, then they would want to use the data standards without opposition.
4. *Plan for ML's future business needs requires consideration of long-term maintenance costs of data standards:* Data standards serve both current and future purposes, both of which must be taken into account when implementing data standardization initiatives. Currently, the CFO Committee is concentrating on instituting data standards based upon today's business needs. This is good because these needs will be met as the standard is developed. However, ML needs to consider how they must respond to future changes in the needs of the organizations as well as in its business processes. Planning for the future is important because data standards can be designed to be flexible to maintain without the firm incurring huge investment in time and money. Lack of planning not only can lead to incurring additional cost in redesigning and implementing changes to the standards and IT systems, but also to losing credibility and buy-in within the organization. Evidence from the negative effects of not foreseeing the future come from other organizations that have failed to take into consideration unexpected changes in the environment. These changes may include the emergence of new technologies or paradigm shifts that force an organization's data standards to be more flexible to meet new needs ([1], p. 305). For instance, at Dobbs Insurance Pension business division, the customer that is the focus of marketing activity shifted away from an organization with many employees to the individual employee who makes his or her own decisions about what companies and product he wishes to invest in. This change in the marketing focus, not only forced Dobbs Insurance to undertake major changes to its data standards, but also to

incur additional cost in modifying its IT systems to meet this unit's new business need ([1], p. 305). In addition, we have seen examples of data standards that met current needs when the standard was first developed, but are now facing problems under current global competitive conditions. For example, CUSIP was developed for US CMFS firms in a time when computer disk space was very expensive. Thus, the most important consideration of that time was to design a numbering system as short as possible. Today, data storage price is relatively low and is no longer an issue. However, the adoption of CINS has increased costs for US firms trying to adopt it because it uses a more extensive numbering system, one that requires firms to modify their back-office IT systems. More importantly, as we have emphasized in section 4.2, without the buy-in of U.S. CMFS firms CUSIP will continue having proving problems enforce the use of CINS. Another example that illustrates the importance of planning for the future is the "Year 2000 bug (Y2K)" that is affecting many IT Systems worldwide. Thus, we recommend that ML perform future scenario analysis to:

- Evaluate how flexible their data standards to be able to meet future needs. This analysis can provide valuable knowledge that could be translated into lower long-term costs (*Factor 1 & 2*);
- Take into account the additional cost to upgrading IT systems they would incur in making changes (if and when necessary) to a data standard as they try to meet future business needs(*Factor 2*);
- Identify the life span of a data standard, which is the limit beyond which it is no longer worth upgrading it and when they would be better off replacing it with a new standard that is less expensive but suitable to the new business needs.
- And, it is important to understand and develop the cost and business models to help plan the transition and evolution of data standards as an on-going important business process (just as a manufacturing firm plans the replacement of obsolete equipment).

5. *Perform "Backtesting" to Analyze the Impact of ML's Data Standards on the Information Value Chain.* It is valuable for ML to perform "backtesting" analysis, a model simulating the data standard to assess the impact that the data standard would have on different activities in the Information Value Chain (IVC). IVC is the process of aggregating data to answer Senior Management questions. In order to perform "backtesting" analysis, ML needs to develop a model, run historical data through the model, and see how effective the new process is in answering a question that was previously answered under the current IVC. If this "back testing" results in making the current IVC more efficiently (i.e. requiring less time and effort needed to answer a question), then the CFO Committee can measure the magnitude of the impact the data standard will have in the organization. Thus, "backtesting" can:

- Provide ML with *Valuable Learning* about the potential impact the data standard will have in the Value Chain of Information prior to its implementation (*Proposition 14*);
- Suggest other information integration issues which might shorten the time to provide Senior Management Reporting; and
- Enable ML to *continue refining* the data standard until they can achieve the goals they are expecting from it, prior to making a huge investment in its implementation (*Factor 2 & Proposition 5*).

This section illustrated the problems of lack of standardized data structures have on a major CMFS firm. PRI and the CFO Committee initiatives have been launched to find solutions to this problem. In sum, we applied the factors and propositions that we presented in Section 3 and in comparison to other case studies found in the literature to analyze these efforts in two ways. First, we evaluated what ML has been doing well. Second, we provide recommendations to those areas that are critical to ensure a successful implementation.

6. CONCLUSION

We have looked at the evidence of previous and ongoing examples of data standards that firms (or industries) that have implemented solutions to problems of coordinating the flow of information across their subunits. Since non-CMFS firms with informational problems have been able to solve their problems, the evidence suggests that CMFS firms can also gain from the benefits of data standardization. As the literature shows, these benefits are improved information for organizational-wide communications and improved operational coordination between subunits. In short, this paper showed that data standardization has facilitated the collection, comparison, and aggregation of data from these various parts of an organization leading to better understanding and decision-making.

Our research also indicated that undertaking a data standardization initiative is not an easy task. We provided factors and propositions that come from observing those firms that have struggled in their attempts to standardize data across their business units. Our observation from these cases is that firms failed to take into account or did not have a good understanding of the implications that comes with data integration initiatives. Thus, it is important for firms to understand how data standardization impacts the organization for the following reasons that we elaborated upon in this paper. First, business functions may lose flexibility to meet unique needs and this requires that the firm find a balance in meeting both global and local needs. Second, there are also up-front as well as long-term costs involved in designing and implementing integrated systems. Since new global and local needs may arise in the future, firms need to analyze how flexible their data integration efforts are in meeting unrecognized future needs. This will help firms avoid incurring high costs in redesigning all their systems. Third, Senior Management needs to see data standardization efforts as critical to the success of their business strategy. This will prevent that other non-monetary factors such as power and politics affect their successful design and implementation of data standards.

Lastly, using the previous and ongoing research presented in this paper, we evaluated the data integration efforts of a major player in the CMFS industry, Merrill Lynch. We highlighted those areas that ML may not have yet considered, and provided recommendations to assist them in the design and implementation of data standards within a firm. In sum, data integration efforts as we presented throughout this paper will enable CMFS firms, such as ML, to coordinate information across its various business units and IT systems to meet their respective information needs.

7. REFERENCES

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