Architectures for Financial Consolidation: A Comparative Study

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Although financial consolidation systems may share such similar components as algorithms and data structures, many systems designers are unfamiliar with the corresponding attributes of different consolidation architectures. As a result, some designers fail to select the best consolidation architecture for their clients. This article examines and analyzes corporate financial consolidation in five firms and illustrates how to match the correct system to the organizational structure of your firm.[1]

The five firms studied here are all extremely large—their 1985 revenues each exceeded $5 billion. Three firms (designated A, B, and D) operated in approximately 100 countries; two firms (designated C and E) operated in more than 20. Each firm consolidated financial data from at least 300 lowest-level reporting units in the course of preparing consolidated corporate statements. The research sites thus formed a generally homogeneous set in that all are very large firms operating in the US and overseas. (In this article, reporting unit, division, group, subsidiary, and corporation refer exclusively to the organizational levels that appear in Exhibit 1.)

The industries represented include computer and communications, energy resources, consumer electronics, and personal services. Although several of the firms owned subsidiaries in somewhat different lines of business than the parent, none of the research sites was a true conglomerate. In addition, only Firms A and E operated in overlapping industries to a significant degree.

Three distinct architectures for financial consolidation emerged from this study: stepwise, direct, and single level. A hybrid of the stepwise and single-level architectures also emerged.

Stepwise consolidation architecture

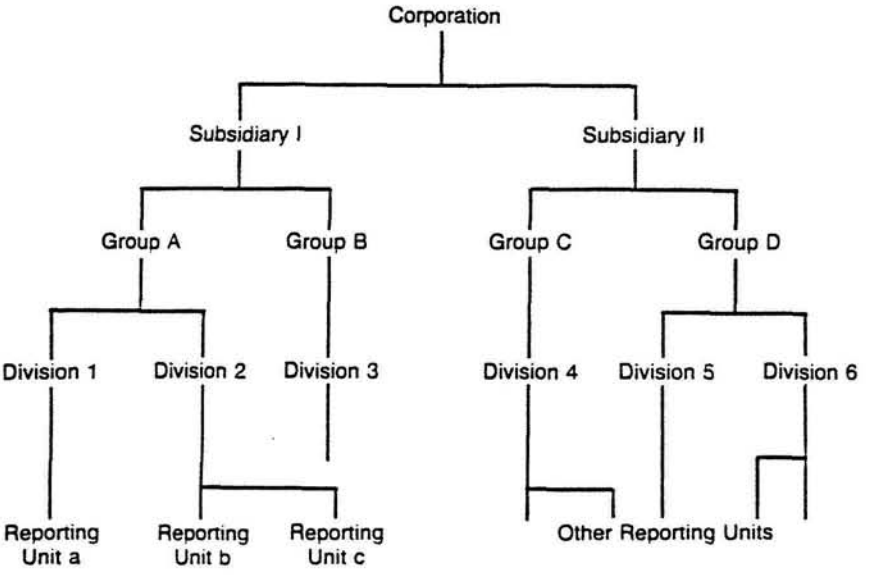
In stepwise architecture (see Exhibit 2), each division, group, and subsidiary is responsible for performing its own consolidation, the output of which becomes input to the next higher-level consolidation. Each division, group, and subsidiary also performs its consolidation through use of a cloned version of the corporate consolidation system. When the corporate system is modified, the clones are modified accordingly.

Firms A and B use the stepwise architecture. This system is directly mapped from the hierarchical reporting relationships (shown in Exhibit 1) into a computer-based system. The advantages of the stepwise architecture are the efficiencies that result from its consolidation processing and data transmission requirements. These efficiencies include the fact that each consolidation is performed once and only its output is transmitted to the consolidation process at the next highest level. The major disadvantage of this architecture is performance related; each consolidation can begin only after all its lower-level consolidations are complete. This results in the slowest branch dictating the speed of the parent consolidation. A secondary disadvantage concerns the potential for problems with data integrity—the corresponding entries for a transaction between reporting units subordinate to different divisions, groups, and subsidiaries may become garbled in transmission and aggregation as they pass up the consolidation hierarchy. Reconciliation may be complex, ultimately involving corporate headquarters, the two units, and each intermediate level.

Direct consolidation architecture

In direct architecture (see Exhibit 3), the cor-

Exhibit 1. ***Relationships Among Organizational Entities***

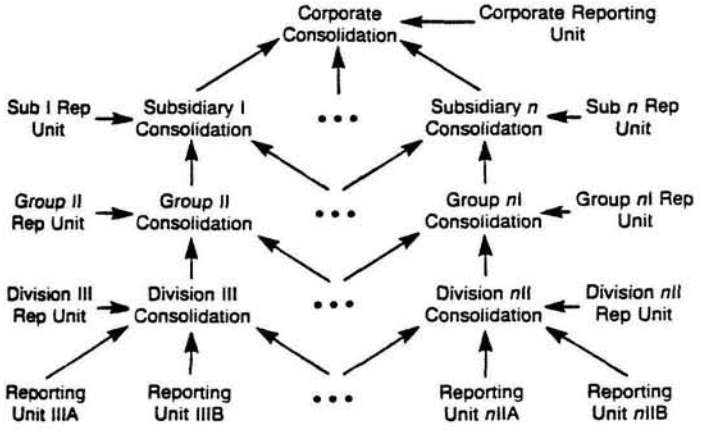


porate level is responsible not only for the corporate consolidation but also for the entire set of intermediate consolidations. The input to the corporate consolidation are general-ledger summaries from each reporting unit—no consolidation occurs before the data enters the corporate system. In addition, divisions, groups, and subsidiaries may operate their own independent consolidation systems, but these systems play no role in the corporate consolidation process.

For corporate consolidation, a single consolidation system operates at corporate headquarters. The independent consolidation systems, if any, used at intermediate levels of the organization simply do not exist.

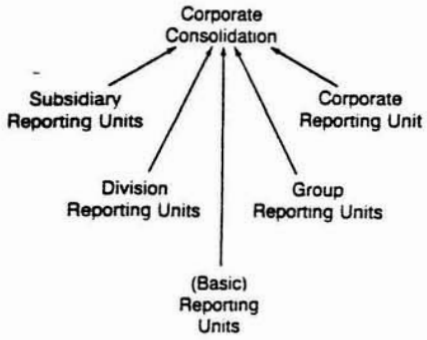
Firm C uses the direct architecture. Here, each

Exhibit 2. ***Stepwise Consolidation***



Note:
All consolidations were done using the same system, though possibly at different sites.

Exhibit 3. *Direct Consolidation*



Note:
One consolidation was done to prepare corporate financial statements. At each intermediate management level, an independent consolidation was prepared, also through direct consolidation.

reporting unit transmits its summarized account balances directly into a huge, multilevel consolidation. Thus, no intermediary steps are necessary. This architecture should also produce corporate financial statements faster and should resolve discrepancies more efficiently because intermediate consolidations are less likely to garble account balances. As one member of Firm C stated, "We've done a good job in [terms of] speed—getting the information in fast—and quality and integrity, a tremendous job. The numbers are rock-solid now, as opposed to where they were a couple of years ago."

Unfortunately, a few drawbacks result from direct architecture's advantages: a huge processing load is periodically placed on the corporate computing environment, processing redundancies and associated inefficiencies may exist because each consolidation is performed by at least two organizational levels, and a larger data transmission load is required.

Single-level consolidation architecture

In single-level architecture (see Exhibit 4), each subsidiary is responsible for producing its own consolidated financial statements, which become input to the corporate consolidation system. The boundaries of the corporate consolidation system do not extend past its interfaces to the subsidiaries' systems—the latter are more correctly regarded as part of the environment than as part of the consolidation system itself.

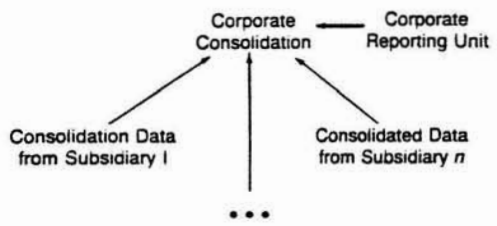
Single-level architecture involves multiple independent systems operating at different points in the consolidation hierarchy. From the corporate consolidation's point of view, only the subsidiary-level systems are visible; they mask the group-level and division-level systems. The subsidiary-level consolidation systems are black boxes that provide input to the corporate system.

Firm E employs the single-level architecture. Its major advantages are its relatively small corporate processing requirements, its flexibility, and the ability to develop single-level systems within a relatively short time frame. Its disadvantage is its total reliance on the subsidiary-level systems to produce accurate data on schedule. In other words, it relies on independent systems for accurate and timely production.[2] These factors suggest that the single-level architecture may be a viable alternative for a firm that either has subsidiaries currently operating highly satisfactory but incompatible systems and incurring relatively few inter-subsidiary transactions or anticipates a high degree of acquisition and divestiture of subsidiaries in the near future. Because this architecture is simple to develop and install, it can also be employed to provide interim consolidation capabilities while a system employing a more organizationally comprehensive architecture is being developed.

Hybrid consolidation architecture

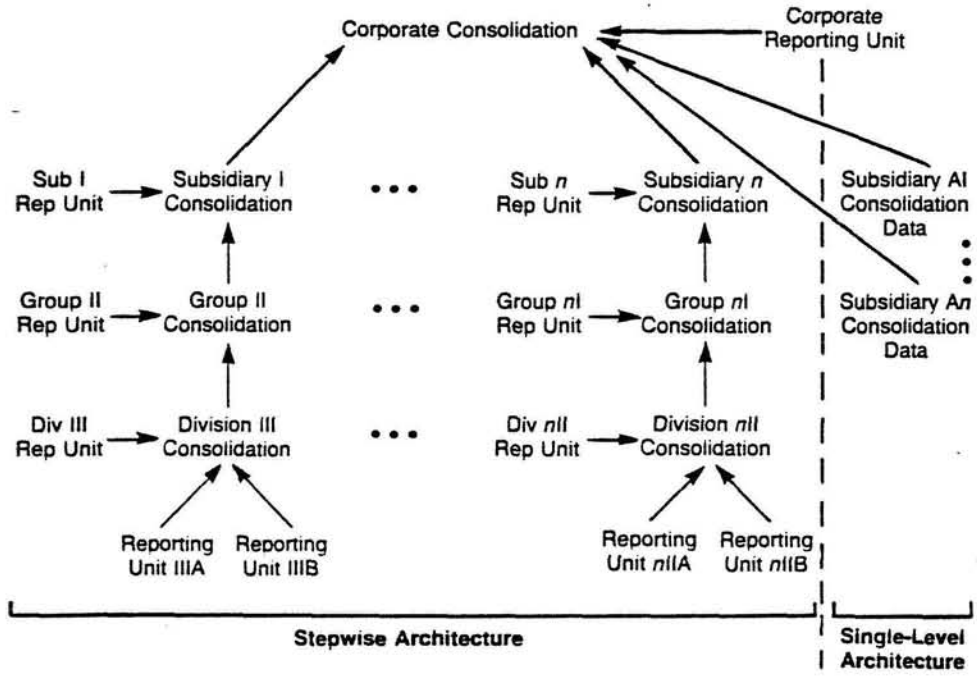
Firm D's consolidation system is a hybrid, embodying elements of the stepwise and single-level

Exhibit 4. *Single-Level Consolidation*



Note:
Each subsidiary runs its own consolidation system.

Exhibit 5. *Hybrid Consolidation Architecture*



architectures. This is illustrated in Exhibit 5; the subsidiaries on the left employ the stepwise consolidation path resembling that shown in Exhibit 1, and those on the right use completely decoupled systems to prepare their own consolidations. These consolidations then feed into the corporate system in single-level fashion.

Hybrids usually combine the best qualities of two systems or entities, but this is not the case for Firm D's system. It exhibits none of the modest processing requirements, consolidation speed, or conceptual simplicity of Firm E's single-level system. Neither does it provide the efficiency of consolidation processing and transmission enjoyed by Firm A's stepwise system. Currently, Firm D is considering conversion to a pure single-level system.

Implications for design and use

No single consolidation architecture is best. Rather, each has a unique combination of advantages and disadvantages. This section presents some indicators of relative system performance, discusses potential implications of different architectures on the organization itself, and provides guidelines to help companies with the make-or-buy choice for consolidation systems.

Indicators of consolidation performance

One indirect index of the quality of a system is the frequency of its use. The better a system is, the more frequently people will use it on those occasions when its use is discretionary. Exhibit 6 depicts the approximate frequency of annual use of the five consolidation systems studied here. Clearly, factors beyond the consolidation architecture employed could and probably did influence these figures. For example, systems that are used less frequently may simply represent uninspired implementations of their respective architectures, or their use may be restricted by limited processing capacity at the corporate DP center.

A second indirect indicator of consolidation system quality is the estimated length of the various consolidation cycles. Exhibit 7 contrasts the reported lengths for the research site firms, from the end of the fiscal period to the internal availability of consolidated financial reports. Again, it is likely that factors beyond the architecture employed here played a role in the variance in these

Exhibit 6. ***Estimated Frequency and Purpose of Financial Consolidation System Use (Annual)***

Firm	Monthly Consolidations (Flash) Condensed	Monthly Consolidations Full (8 Per Year)	Quarterly Consolidations (3 Per Year)	Annual Consolidations (1 Per Year)	Budgets	Pro Formas	Forecasts	Total Annual Cycles
A	No	Yes	Yes	Yes	*	*	*	12
B	*	No	Yes	Yes	*	V	*	4+
C	Yes	Yes	Yes	Yes	V	V	12	36++
D	*	No	Yes	Yes	*	*	*	4
E	*	Yes	Yes	Yes	5	V	2	19+

Notes:
* Done by way of another system.
V Varies.

values, but this data provides some measure of the relative performance of the five systems. Direct architecture (employed by Firm C) and the single-level architecture (used by Firm E) consistently outperform the systems using the stepwise or hybrid architectures.

Implications for organizational culture

The choice of a consolidation architecture is not a purely systems decision, nor are its implications restricted to the accounting and DP spheres. Because different architectures clearly affect a firm's image, top management guidance on this question should dictate the outcome of the architecture selection process. The clearest example of this concerns the degree of autonomy lower-level organizational units experience under different architectures. In firms using stepwise or single-level systems, the corporate financial staff receives detailed information depicting business activity at the reporting unit level only with the acquiescence of subordinate levels of management. The reporting units' general-ledger summaries are input to the subsidiary consolidations, but are not themselves customarily sent on to corporate headquarters. This allows intermediate levels of management greater flexibility to make decisions which may have a negative impact on a reporting unit's performance in the short run because the stability of the affected division's and group's financial performance can be maintained by consistent results from other reporting units and divisions.

The performance of individual reporting units cannot be masked in firms using direct consolidation systems. Lower-level management may make such decisions, but not without their implications quickly becoming apparent to corporate headquarters. Thus, the stepwise and single-level architectures and the direct architecture reflect differing basic assumptions concerning corporate headquarters's degree of privileged access to detailed

Exhibit 7. ***Approximate Duration of the Consolidation Cycle (in Workdays)***

Firm	Monthly			Quarter's End		Year's End	
	Condensed Profit and Loss Consolidations	Full Profit and Loss	Full Balance Sheet	Full Profit and Loss	Full Balance Sheet	Full Profit and Loss	Full Balance Sheet
A	—	9	14	9	14	12	14
B	—	*	—	15	15	30	30
C	3	8	9	8	9–10	10	12
D	10–12*	—	—	10–12	13–17	10–14	13–20
E	7*	8	8	8	8	20	20

Note:
* Done by way of a different system.

information on the operating results of lower-level entities. As a member of Firm C stated, "We regard the reporting of this information on a regular basis as being part of the price a reporting unit pays for being part of Firm C." The top management at Firms D and E, on the other hand, has espoused policies encouraging greater management initiative at the organizations' lower levels. This was one factor involved in Firm E's choice to employ a single-level system and is one factor underlying Firm D's current deliberations on the possibility of changing to a single-level system.

The design of every information system is based on a set of assumptions, implicit or explicit, about the nature of the organization in which it will be used. The more homogeneous the organization is across its subsidiaries, groups, divisions, and reporting units, the more sense it makes to employ either stepwise or direct systems. In such heterogeneous firms as conglomerates, the flexibility implied by the single-level system may be required.

Comparing the three architectures

Exhibit 8 is a comparison of the three architectures. Because no single architecture can be con-

Exhibit 8. ***Comparison of Consolidation Architectures***

Factor	Architecture		
	Stepwise	Direct	Single Level
Speed	Slow	Fast	Dependent*
Data Reliability	Fairly Good	Very Good	Dependent*
Development Cost	High, but Spread over Multiple Units	High	Low
Processing Cost	Low	Very High	Low
Data Transmission Cost	Low	Very High	Low
Implied Autonomy of Subsidiaries	High	Very Low	High

Note:
* Dependent on lower-level consolidation systems.

sidered generally superior to the others, this comparison emphasizes the importance of determining the most critical performance attributes for your firm, along with those that can be traded off. All other things being equal, a firm that is concerned with standardizing its consolidation process and minimizing overall costs will choose the stepwise architecture. On the other hand, a firm that prizes short consolidation cycles and high data integrity will prefer a direct architecture. The single-level architecture can be developed quickly and inexpensively, is flexible, and, at least in one firm, can consolidate as fast as the direct architecture.

In-house development versus packages

The use of commercially available consolidation software packages can save the time, cost, and uncertainty associated with in-house software development. What factors should influence your firm's decision to develop or buy a consolidation system? Outside of the usual set of issues associated with the acquisition of packaged software,[3] there are several important selection factors specific to the context of consolidation. The following questions should be considered:

- Do the package's implicit assumptions about the context within which consolidation will occur match the situation in your company? This could include autonomy and business homogeneity issues.
- Do the package's implicit assumptions regarding the nature of data to be consolidated encompass the range of data you wish to consolidate? Specific questions include the level of detail required or desired; the ability to use a single system for consolidation of budget, forecast data, and actual data; the ability of the system to consolidate nonmonetary data (number of employees, number of square feet of production and office space, and volume of sales); and the ability to consolidate as frequently as desired without overwriting data from earlier periods or tying up unused storage space.
- Does the package allow for the downloading or transfer of data files to spreadsheets and other financial analysis software in common use in your firm?

If one or more of these factors doesn't match, your firm may still elect to use a given software package. Be advised, however, that significant modification of the software or your organization will probably be required.

Conclusion

Systems based on the stepwise architecture, which most closely resembles the reporting relationships on the typical organization chart, offer low cost of consolidation processing and standardization. Direct architecture systems can shorten the consolidation time frame and improve data integrity, by having each individual reporting unit transmit its general ledger summaries directly to corporate headquarters, which performs the entire consolidation in one fell swoop. In the single-level architecture, the corporate system consolidates only over a single level. Subsidiaries and lower-level units of the organization operate their own, independent consolidation systems, which operate as black boxes to provide input to the corporate system. The single-level system's major advantages appear to be its flexibility and its quick and inexpensive development.

Each of these architectures has disadvantages as well, but more important, each has implications for the organizational climate of the firm. When the climate and the architecture's implications do not match, user resistance and misuse (or abuse) of the system are likely to occur.[4] The greatest challenge that users and designers of systems for financial consolidation face is not understanding consolidation or computer-based systems but forecasting how successfully the introduction of a computer-based system will complement the firm's existing constellation of rewards, values, norms, and routines and taking the appropriate steps to ensure that it will.

William C. Sasso, PhD, MBA, is assistant professor of information systems in New York University's School of Business. His research interests include the empirical investigation and descriptive modeling of the systems development process; comparing the elements, organizations, and performance of functionally equivalent information systems; and modeling the chains of activities organizations use to process information.

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Notes

1. The author conducted structured interviews with members of the financial reporting, financial systems development, and information systems planning staffs at each firm. Copies of the structured interview questionnaire and additional details regarding the data collection and analysis process can be obtained by writing to William Sasso, New York University, 90 Trinity Place, Room 700, New York NY 10006.
2. This reliance need not be a disadvantage; as discussion will show, Firm E's system is clearly one of the fastest systems in the study. Members of Firm E felt that the degree of data granularity their system provided was adequate for their needs; they were highly satisfied with the level of data integrity implied by their system.
3. These general issues include such questions as What kinds of experiences have firms generally comparable to yours (in size, industry, and hardware environment) had with this package and this vendor? and How much faith do you have that the vendor will remain in business over the package's anticipated period of use in your firm?
4. M. Lynne Markus, *Systems in Organizations: Bugs and Features* (Marshfield MA: Pitman Press, 1984).

Recommended Reading

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