
Introduction:

“Architecture is 90% business and 10% art.”

With this often quoted statement, Albert Kahn sought to differentiate his firm’s approach from that of his peers and competitors in the first half of the twentieth century. Coinciding with the rapid industrialization of the American economy during this period, Albert Kahn Associates (AKA) developed to be the premier industrial architects of this country, if not of the entire world. Kahn’s practice, originally founded in 1895 as Nettleton, Kahn and Trowbridge, embraced technological innovation from the very beginning, and focused on applying new approaches to emerging markets with new and specialized demands. Most notably, Kahn is credited by many historians with creating the architectural conditions necessary for the development of the continuous assembly line by Henry Ford, an early and long-standing client of Kahn’s.¹ In fact, the automotive industry has continued to be the largest market segment served by AKA to this day. But the firm has never concentrated solely on industrial architecture, and their practice has been broadly focused on other segments like office, educational and institutional buildings. Today, health care facilities form the second largest segment served by AKA.²

Although it is easy to trace the clear continuity in AKA’s attitude and approach from its founding to the present, major changes in their key market segments combined with evolutions in the focus and performance of design services have pushed AKA to continually seek newer and more effective ways to differentiate themselves. While early initiatives in

¹ For a brief history of Albert Kahn Associates, see www.albertkahn.com/cmpny_history.cfm; for more extensive information, refer to: Albert Kahn, Architect of Ford, Federico Bucci, Princeton Architectural Press, 1993. For a more recent depiction of the firm’s work, see: Albert Kahn Associates, Continuing the Legacy, L’Arca Edizioni, 2000
² See Illustration #1 for AKA’s 2002 market segmentation, and Appendix #1 for a current firm profile
concrete technology led to enhanced fire resistance, improved lighting and ventilation and increased structural spans for needed programmatic flexibility, the potential for innovation in the physical aspects of industrial architecture has been eclipsed by new challenges for pre-design and project-delivery services in response to client’s needs for faster construction schedules and greater responsiveness to the increasing complexities of today’s manufacturing environment. AKA is responding to these challenges through the development and deployment of new, knowledge-based 3D and 4-D design technologies combined with an enhanced range of professional services. Under the umbrella of the ‘Digital Factory’ initiative, the firm’s investment in new information technology is coupled with a wide range of additional services marketed by their wholly owned subsidiary: Kahn Global Services, Inc. which provides process engineering, program management, and business and manufacturing consulting in support of Albert Kahn Associates, Inc.’s core A/E services.

The ‘Digital Factory Initiative’ and the Search for Sustainable Competitive Advantage:

By the Spring of 2003, AKA’s premier technology investment, involving the use of the most advanced, object-oriented 3D modeling software in conjunction with ‘lean-design’ practices, was at a turning point. Bob Mauck, AIA, PE, Senior Vice President and Director of Advanced Design Technologies had just participated in a conference call with members of his staff and industry analysts in order to chart out possible directions for AKA’s technology initiatives. The key question going into the call was how a service-oriented A/E firm like AKA can leverage its investment in new technology most effectively in order to maximize their competitive advantage in the A/E industry. This question has proved to be more difficult than anyone had imagined, with potential responses ranging from simply trying to make their internal processes more efficient, to pushing for major realignments within the construction industry supply chain. These potential directions, and their risks, costs and potential rewards will form the core of this case-study.

Background, development of the Digital Factory Initiative as a Response to Automotive Industry Demands:

AKA began developing a technology initiative under the borrowed name of “Digital Factory” in response to several of its automotive industry clients who became interested in extending
their advanced 3D automotive design processes into the design of their factories and facilities as well.

For example, AKA designed several plants for Chrysler who used Catia software extensively for product development and who wanted a “seamless pipeline” in facilities design and development, also using Catia. This desire to apply product design technologies to their buildings is most notable among German manufacturers who have ‘gotten a little further ahead’ of the Americans and especially the Japanese according to Bob Mauck, who characterized them as being ‘more deliberate,’ seeking ‘incremental change’ in their facilities design processes. A good example of the German’s ambitious approach is Daimler-Chrysler who have established a mandate that by 2005 all their plants will be designed using object-oriented 3D solid modeling.

The driving force behind the adoption of this technology in the auto industry is the need to eliminate inefficiencies in the design process in order to keep pace with the increasingly fast time to market for new car models. In the past a new model might come on line every 5 or 6 years, leaving several years to design and build a new plant. During the last decade however, these product development cycles have been speeding up to the point that today, it is not uncommon for new models to go from concept to production in as few as 24 months. According to Bob Mauck, this extremely short time-to-market “places the building on the critical path, and the fact that the building could become a bottleneck in their clients business cycles puts a lot of pressure on the A/E/C industry.”

The core of the Digital Factory initiative is 3D object-oriented digital modeling. With this technology, designers almost literally ‘construct’ the building out of discrete parts such as beams, slabs and ducts. Because they are discrete digital ‘objects’ and not just a series of lines or surfaces, these components can be measured and counted for quantity surveys, digitally analyzed for structural performance, and automatically checked for potential interference between various systems (a duct running through a beam for example). The Digital Factory Initiative at AKA combines object-oriented 3D modeling and information-based “4D” scheduling technologies with lean-design and lean-construction practices.

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3 See Illustration #2 for a graphic representation of auto industry product development cycles and the impact on facility planning and construction.

4 For more information on “4-D” technologies, refer to Martin Fischer’s “4D CAD Research” at the Center for Integrated Facility Engineering at Stanford University, www.stanford.edu/group/4D/
Inspired by “lean-manufacturing,” an approach pioneered by Toyota more than 40 years ago and called the “Toyota Production System,” lean-design focuses on the elimination of inefficiencies in the design process by analyzing and coordinating tasks and promoting collaboration. AKA presents its application of lean-design on its website in this way:

As AKA’s operating system has evolved though our commitment to TQM, TQS, Q-1, and ISO, the resulting improvement efforts have emerged as “Lean Design”. It is, as we call it, Albert Kahn Associates Best Practice.

The Advanced Project Planner tool emphasizes a clear, focused approach to design, planning contributions from both outside and internal sources.

An important part of the Digital Factory initiative is the customized linkage they are developing between the modeling technologies and their ‘Advanced Project Planner’ project management tools. According to Bob Mauck, a design project is “all about information, and waste exists in the hand-off of information,” which occurs multiple times between numerous and fragmented project participants. Using the 3D / 4D digital model as the single repository of project information facilitates collaboration and generates enhanced efficiencies in the flow of project data. The goal, and the potential payoff of lean-design is the opportunity to rethink workflow in significant ways. Part of the importance of the Digital Factory initiative is to develop data and modeling standards that can allow project information to be shared effectively among project participants and to be stored for use in future projects and for post-construction facilities management.

One key challenge for AKA has been the variety of software standards used by their different automotive industry clients. While Chrysler works with Catia, GM uses Bentley’s Microstation exclusively for its facilities. Because their clients want to be able to use the building model for manufacturing process engineering and facilities management purposes, it is important that the building be modeled in the same software that they use for these other activities. Consequently, AKA has been developing modeling capabilities in Catia, Microstation, Autocad and even Pro-Engineer. According to Samir Emdanat, a key member of the Digital Factory team, it would be a ‘real stretch’ to find a single application that could address the needs of their different clients or that could allow for file translation between these different software platforms. As a result, AKA has followed a practice of assembling specific project teams for each digital factory project and training them in the software.

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5 For information on Lean-Design and Lean-Construction, refer to the Lean Construction Institute’s webpage, www.leanconstruction.org
required for that particular client. They currently have about 3 or 4 teams working with different clients, but these teams aren’t dedicated to ongoing work with a single client, and the teams are shifted and re-constituted for different projects. Bob Mauck reported that, despite the multiple platforms being used, they are seeing internal efficiencies in their design processes, “once the team members get comfortable with working fully in 3D.”

It is important to note that object-oriented 3D modeling isn’t just another way of drawing, but it represents a powerful new way of incorporating construction and performance information in the model itself. This has important implications for the designers and engineers who have to adopt a new mentality about the way their work is performed and coordinated. The necessary changes in the designers approach and in the office culture are an added challenge in implementing new design technologies within the firm itself.

Changes in Project Delivery Methods: The Digital Factory and the A/E/C Industry Supply Chain:

Bob Mauck expressed the conviction that the real efficiencies of 3D / 4D and lean-design and lean-construction lie in rethinking the A/E/C industry supply chain. For him, the important changes will result from “not just automation of the old tasks, but from fundamentally changing the supply chain and rethinking the whole workflow.” These opportunities however, are dependent on changes in how the owners contract for facilities procurement. Traditional design-bid-build delivery methods discourage the kind of collaboration and information sharing that can lead to real efficiencies in construction. As more and more automotive industry buyers explore “design-build” or “bridging” delivery methods, new opportunities will open up for designers and contractors to share information (and risk) and to deliver increased schedule and cost efficiencies. For the time being however, the focus for his automotive industry clients is “still on the lowest contract price, taken on a contract by contract basis for all of the pieces separately, rather than on the lowest delivered cost for the entire project.” If looked at from the point of view of the whole process, he’s sure that an at-risk consortium of designers and contractors could realize significant efficiencies through information sharing and lean practices.

As a result, AKA has been proactively cultivating collaborative relationships with other members of the A/E/C industry supply chain, specifically with key project subcontractors like
steel fabricators and HVAC system installers. Some automotive manufacturers have begun to consider design-build as an alternative to the design-bid-build project delivery methods that have typically been followed. Although they haven’t had the opportunity to team with a GC on a design-build project alliance, Bob described a recent project that was intended to be bid as design-build among several consortia of A/E’s and GC’s. This would have been a good opportunity for AKA to test the potential of 3D / 4D technologies combined with lean-design in a close collaboration with the contractors, but the project was moved overseas and a more traditional project delivery method was eventually employed. None the less, Bob emphasized the importance of AKA’s preliminary efforts to create informal alliances with contractors on a pre-project basis because, as he pointed out “…once the RFP is announced its already too late; we need to anticipate these opportunities.”

While he also pointed out that “the (4D) technology is not mature yet,” he did note that “AKA is working with a few key contractors to develop a comfort level in order to be able to bid future work.” In the meantime they are focusing on shared efficiency initiatives with certain contractors, like the potential for digital coordination between structural steel engineering design and the fabricator’s production of shop drawings. With general contractors however, the process of change might be more incremental. Bob pointed out that the reason everyone keeps multiple project logs is to provide cover for potential disputes. This duplication of effort is inherently inefficient, and he made the point that convincing an owner and contractor to share one log, posted on-line, is in itself a step in the right direction. Still, Bob pointed out that:

“We won’t get too far until we are willing to stick our collective necks out and go to an owner to deliver the entire project for a fixed price, making our profit by squeezing the inefficiencies out of the system.”

Potential Directions for the Future of the Digital Factory Initiative:

Although their Digital Factory initiatives to date have allowed AKA to meet the demands of their automotive industry clients, it has been clear for some time that its potential extends well beyond serving the needs of a single client group. If AKA can find a way to effectively implement their Digital Factory initiative in more projects and in new ways, they should be able to generate significantly increased competitive advantage. Although they are
technology leaders today, other A/E’s are probably not far behind them in developing such technologies themselves, and the question still remains as to how AKA can leverage their unique industry insights and growing technological sophistication into sustainable competitive advantage in the long run.

As a result of the conference-call in the spring of 2003, four possible directions were charted out for the future of the Digital Factory Initiative. These four potential paths are presented and analyzed in the following paragraphs.

One:

**Continue to Develop In-house Technology Capabilities to Serve Existing Client Needs**

The first option is for AKA to continue and intensify their current technology initiatives that focus on serving multiple clients with widely varying technology standards. Such an approach should focus clearly on developing internal efficiencies in the design process, with the goal of delivering consistently high quality service at a lower cost. In a world of continually shrinking design fees, optimizing internal processes and thereby reducing production costs are necessary to maintain competitive advantage and profitability.

Expertise in various modeling technologies must be developed and maintained. One way to make this process more efficient might be to maintain project teams that specialize in each of the major 3D software environments (Microstation, Catia, Autodesk’s Revit, etc) rather than assembling teams on a project by project basis. Each of these teams could be assigned to focus primarily on the needs of one particular client or a group of clients with similar technology needs. A simultaneous effort would be needed to develop in-house standards or customized software to help maintain consistency, improve process optimization through lean-design approaches and to allow for the collection and sharing of project data and accrued knowledge. This might involve efforts to develop or acquire translation software or other digital tools to enhance inter-operability between the various software platforms.

In this scenario, the potential efficiencies inherent in these 3D and 4D modeling capabilities are likely to be offset by the waste associated with duplication of effort in trying to address the specific technology needs of each client. Maintaining and expanding technology capabilities in multiple design platforms precludes many economies of scale, and the costs of this approach are likely to be very high. Not only do smaller numbers of each system
need to be licensed and supported, but employee training would be more complex and costly and the flexibility to move staff resources between different projects would be reduced. These costs could potentially be offset by trying to focus on one or another of these different platforms and trying to extend its use to as many other market segments as possible. Since Health Care represents 25% of AKA’s work, if all future Health Care projects at AKA could be designed using one system and if that system was also used in one third of their Domestic Industrial and Automotive work (1/3 of 45% = 15%), then that system would potentially be in use on half or more of AKA’s projects. This might then represent an incremental move toward a standard, or at least a dominant technology paradigm within the firm, and thereby begin to generate some internal economies of scale.

The major benefit of this approach is that it maintains AKA’s existing strategy of differentiation by focusing on the specific needs of each client, and it wouldn’t likely alienate any current clients. Its major drawback seems to be the built-in inefficiency of the duplication of effort in implementing and maintaining multiple systems and standards. Firm-wide economies of scale are unlikely to be realized easily or soon, and therefore, the possibility of realizing real internal cost savings seems remote. This approach to deploying new technology is unlikely to transform the nature of the design services industry and will probably maintain the status quo of buyer-supplier power and existing competitive positions. Other approaches with greater potential to re-shape market forces or to enhance competitive advantage need to be explored.

**Two:**

**Focus on Fostering Industry-wide Standards and Developing New Services**

Another approach is to try to encourage clients to adopt or accept technology standards for facilities design and maintenance. This can be pursued through various avenues such as by lobbying trade-groups to voluntarily agree to standards or by offering incentives for potential clients to accept AKA’s technology standards for their projects. In the Detroit area, the Automotive Industry Action Group has in the past had a sub-group on facilities management issues, but that forum no longer exists. According to Bob Mauck, renewed efforts have been made to get them to participate in a technology round-table on facilities design and management standards. The German Association of Automotive Manufacturers is reportedly discussing the establishment of Microstation as just such a software standard.
for facilities design in that country. Despite the fact that, in his opinion, the German A/E/C industry is more fragmented than our own, Bob expects that the German’s might achieve significant efficiencies by this beneficial alignment of design practices. Although it seems clear that it would be in the interest of American manufacturers to similarly improve their collective ability to compete globally by optimizing facility procurement practices, he knows of no ongoing initiatives on this front among US industry trade groups.

Another approach is for AKA to choose the best technology from among the variety currently on offer, and to encourage its clients to adopt it as their own standard as well. A particularly proactive way to do this might be to develop a rich set of customized tools associated with one software platform and to market those tools aggressively as an integrated set of professional services that extend well beyond those typically offered in the A/E industry. By offering a single-source of value-added services for the entire facility lifecycle, from pre-construction planning through post-occupancy facility management, AKA could provide incentives for clients to abandon their current technology standards in favor of AKA’s. This approach would require a significant effort in developing the new services and in customizing the 3D /4D tools to support those services. Although there does seem to be an increasing desire among many manufacturers to out-source operations formerly performed in-house, an equally intense effort would be required in marketing this new procurement and facilities management approach to their clients. It is clear however, that such an initiative would leverage the power of the digital model as a repository of project information over the entire life of the project, and it would create new opportunities for AKA to provide services beyond those of the typical A/E design consultant.

This more aggressive approach to fostering the consolidation of AKA’s clients’ technology standards, offers several attractive benefits. Since the basic approach is to extend into new but complementary service areas, the consequent fees per project, and the life-span of customer service contracts would both grow. Similarly, since the client is more dependant on AKA and its technology in this scenario, the buyer’s switching costs are higher and their bargaining power is lower. AKA’s industry expertise would be further consolidated and would result in increased barriers to the entry of new competitors. Finally, this approach seems easily translatable to other market segments like Health Care, and it offers economies of scale since the technical infrastructure, skills and knowledge gained in past projects is efficiently translatable to new ones. The major challenges of this approach are
the commitment of resources to developing a single technology standard and the suite of services that it would support, and the risk of leading the firm and the industry in a new direction. It is possible that some clients would be slow in accepting this model for their facilities needs, and some might even reject it outright. Finally, if the customized software tools and the services they support aren’t unique or somehow proprietary, there is a risk of imitation by competitors. Still, the potential to realize significant gains in project efficiency, sales growth and sustainable competitive advantage make this an attractive option.

Three:

**Develop, and Possibly Market, Proprietary Inter-operability Platform for Various 3D Programs –Combined with Information Sharing & Lean-design Tools**

This third approach directly confronts the 'tower of babel' resulting from the great variety of design industry software standards, by proposing the development of inter-operability software that could support AKA’s current operations, or generate a new market if that software were sold or licensed to clients or other design professionals. It wouldn’t be enough however for this software to simply translate information form one file type to another. The real appeal of such a hypothetical application would be its capacity to overlay the 3D models with tools useful in integrating and analyzing project data, implementing lean-design practices and fostering collaboration between project participants using different native software. Such an application would have to be a project management tool powerful enough to support the variety of design, scheduling and operational activities performed over the entire lifecycle of a facility.

The idea of a design firm developing its own software is not unprecedented. The Beck Group, an A/E/C firm headquartered in Dallas, Texas that specializes in commercial design-build projects, has done just that. Their ‘Destini’ initiative is an object-oriented 3D modeling program that is customized for their design-build practice. Features include task automation, systems coordination and the integration of cost and schedule information. On their website, they describe Destini in this way:

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6 See Illustration #3 for a depiction of the multiple software platforms used by project participants in Frank O. Gehry’s Experience Music Project, from Martin Fischer’s “4D CAD Research,” www.stanford.edu/group/4D/
The DESTINI software incorporates object-oriented, parametric modeling technology to develop a rules-based application for the A/E/C industry. This technology will help us design, engineer, estimate, purchase and construct projects substantially faster than is possible today. The goal of this initiative is to enable clients to reduce the total delivery time for their facilities by as much as 40%, with commensurate savings in design and construction costs.

To date, this software tool has been aimed at the commercial office segment of their business, and it has been tested on at least one major project for SBC communications at Pinnacle Park in Dallas. Although Beck’s current plan is to use the software in-house to support their design-build business, it is not inconceivable that they might someday seek other avenues to profit from it. As the firm seeks to grow into other regions and new markets it could choose to establish franchise relationships with new partners who would pay for the use of the technology and the databases of construction industry information that support its use. Depending on the state of the design software market, they might also choose to market the software outright, profiting from the sales, training and support fees it would generate.

Although AKA’s core competency is design and not software development, they do have a wealth of experience along with a host of ‘best-practices’ that would enhance any software that they were to develop or customize. Beyond the simple functionality of the kind of translation utility described here, AKA’s unique integration of lean-design processes and industry specific engineering coordination utilities would represent significant added value for any software initiative that they were to develop. One possible scenario for pursuing such a technology-centered approach might be to team with a software company like Bentley, Dassault or Autodesk, in order to pool their software development and marketing capabilities with AKA’s A/E industry expertise. Another potential partner for such an approach might be a construction industry publisher like R.S. Means who might be interested in helping to develop and market a utility that can integrate various 3D model data with continually updated cost information, paid for on a subscription basis.

Of course, developing new software has huge up-front costs, along with the risk that the payback for this investment might be very slow. It is also susceptible to constant changes in the software and hardware it is intended to work with. This approach offers the opportunity of opening new markets for AKA while at the same time raising the risk that they might lose

7 www.beckgroup.com
focus on their core A/E business. It does address the conundrum of whether one profits from newly developed technology by keeping it in-house and using it to compete in one’s core business, or by pushing it to market in an attempt to profit from selling it to others. Either way, there must be a clear focus not only on how the new technology will serve existing business strategies, but more importantly, on how new technologies can lead to industry transformations, new approaches to markets, and to new ways of competing.

Four:
Enter into Design-Build Alliances with GC’s or CM’s, Using 3D / 4D Technologies to Streamline the Construction Industry Supply Chain

A significant opportunity for integrated, knowledge-based 3D / 4D design technologies is to use them to streamline the construction industry supply-chain. This option is tempting in large part because of the extreme inefficiencies caused by the multiplication of contractual relationships, the duplication of effort and the general fragmentation of the construction industry. Rather than using new technology to streamline the design process for internal efficiencies alone, or even to improve the procurement process purely as a service to their clients, A/E firms now have the opportunity to leverage their ability to integrate industry knowledge early in the design phase in order to take a more central role in the entire project delivery process. This means moving away from the pure design services business model and entering into some form of design-build practice, through alliances or mergers with Contractors or At-Risk Construction Managers. Returning to the example of the Beck Group, they have clearly focused their new 3D / 4D technology efforts well beyond the scope of traditional design services:

Beck has formed the DESTINI initiative to focus on integration of the design, estimating and construction disciplines within the real estate delivery process. It is our goal to develop technology that will dramatically reduce the cost and scheduling associated with the delivery of real estate assets, improve the functionality of the space and enhance our customer’s core business. This will be accomplished by integrating technology with a substantially improved delivery process.

Perhaps this shouldn’t be surprising given the increasing popularity of design-build as a delivery method world wide. According to the Design Build Institute of America, design-build

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8 [www.beckgroup.com](http://www.beckgroup.com)
accounts for as much as 70% of all non-residential construction in Japan and 50% of such projects in Europe. Although it is lagging significantly behind this trend, domestic construction buyers are increasingly turning to some form of design-build as an alternative to design-bid-build delivery methods. Design-build is fast becoming the leading project delivery method in many project types, and design-build contractors are moving beyond their traditionally strong markets in the Manufacturing, Petroleum and Industrial sectors to see strong growth in Commercial and Health Care sectors, and they are now focusing on expansion into Multi-Family Housing, University and Educational markets as well. For example, according to Engineering News Record, the design-build share of the Health Care market grew from 15% to 46% between 1997 and 2001. According to ENR’s construction industry rankings for 2001:

9 of the ENR Top 10 U.S. Construction Companies are Design / Builders
Only 2 of the ENR Top 10 U.S. Design Firms DO NOT also do Construction
6 of the ENR Top 10 U.S. Design Firms primarily do Construction
Only 1 of the ENR Top 50 U.S. Design Firms do purely Architecture, and
Only 2 of the ENR Top 50 do purely A/E and 9 of the top 50 do purely E/A

Although these statistics are self-reported by the firms surveyed and they give no sense of how much these design firms are participating in construction or vice versa, it remains clear that the integration of design and construction is a significant trend in the industry.

The real potential benefits of the new 3D and 4D technologies aren’t that they produce images or drawings faster or more economically, it is that they can allow for the entire construction supply-chain to be analyzed and, to a great extent, optimized for maximum speed and cost performance. However, this potential cannot be achieved in isolation, but only with the clear supply chain visibility afforded by direct access to cost and schedule data that is typically closely guarded by contractors, sub-contractors and suppliers. Therefore, the true potential for new design technologies to transform the design and construction industries is dependant upon different contractual relationships that allow the technology to be teamed with actual cost and schedule information. For example, with real-time knowledge of the supplies of raw-materials and building components, members of the A/E/C team can design to availability and avoid the costly and inefficient cycles of specifying systems that must often be changed and re-bid later.

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9 www.dbia.org
AKA has always differentiated itself by providing very high quality design services to its clients. Design-build practices on the other hand, have a reputation for cheapening the value of design. With a more strategic use of knowledge-based design technologies in order to optimize the construction supply chain however, significant power can be retained by the designers, and design quality can be maintained while customer service is enhanced. While generating cost and schedule efficiencies for the client are primary selling points for design-build, deciding how to capture some of the value of those efficiencies for the design-build team is a major concern. In this regard, it seems that design-build can be particularly profitable when serving clients who, by nature of their businesses, are primarily service- or schedule-sensitive, since they will likely be willing to pay a premium for enhanced performance in these areas.

Design-build alliances also offer the possibility of improved profitability for designers who can share in project and construction management fees along with potential monetary incentives for early or below-cost-estimate project completion. Of course, this potentially greater reward comes along with a certain degree of performance risk that must be shared between the designers and the builders in a project alliance. For this reason, design-build alliances must be based upon solid performance track-records and a high degree of trust between team members. The management tools potentially built into 3D / 4D design technologies, along with the supply chain visibility possible when linking these tools with real industry data, should facilitate both performance and trust between project participants. It should also allow the designers, as stewards of the project information, to maintain a more powerful position than previously possible within a typical design-build alliance.

Evaluating the competitive potential of design-build alliances that are enhanced by knowledge-based 3D / 4D design technologies, as compared with the traditional design-bid-build project delivery method, shows significant advantages for design-build. Barriers to entry for competitors are raised in direct proportion to the sophistication and management effectiveness of the proprietary digital technologies and the quality of the cost and schedule data that they integrate. Both buyer power and supplier power are reduced by virtue of enhanced supply chain visibility, since no player can effectively pursue a ‘divide and conquer’ strategy and since negotiations are pursued from much more transparent positions. Finally, although the threat of substitution and industry rivalry will likely remain little changed, competitive advantage within a reduced field of more sophisticated players
will probably accrue to those who move early in the development and deployment of new digital technologies in support of at-risk design-build project alliances.

Again, for an A/E firm like AKA to jump precipitously into design-build could be costly for their core architectural and engineering design services business. On the other hand, they are likely to experience future competition from firms that offer construction or construction management services in addition to design. According to Bob Mauck, AKA’s automotive industry clients seem hesitant to move away from design-bid-build procurement methods, and an incremental approach to this sort of change is perhaps to be expected. One response would be to situate AKA to participate in a hybrid delivery method called ‘bridging’ as a way to maintain its traditional focus on design services, while also benefiting from participation in design-build alliances.

In a bridging project, the client engages a design firm to establish the preliminary project parameters and to perform schematic architectural and engineering design. The project is then bid among several design-build firms or alliances who compete to deliver the detailed design, engineering and construction for a fixed price. Once chosen, the design-builder coordinates on design development with the original design firm. Perhaps by establishing a subsidiary or subsidiaries that focus on forming design-build alliances with select contractors or construction managers, AKA can maintain its current differentiation as a high quality A/E design consultancy while also entering the design-build market.

Conclusion

The development of new, knowledge-based 3D and 4D design technologies has the potential to change the very nature of design and project delivery within the construction industry much more radically than the introduction of CAD drafting or the development of other digital technologies aimed primarily at visualization. The power of these new tools lies in their ability to integrate management functions and market data into the design process in unprecedented ways. Consequently, design firms like AKA are facing major strategic decisions surrounding the development and deployment of emerging design technologies in the near term. New directions open to technologically sophisticated design firms like AKA range from enhancing internal efficiencies and developing new design services, to pursuing entirely new business models as potential software developers or leaders of at-risk design-
build alliances. The goal of this paper has not been to suggest one path over another, but rather, to articulate four different potential scenarios for the future of the Digital Factory Initiative, and to elucidate some of the competitive forces and strategic implications of each one. The future of the A/E/C industry is impossible to predict, but new 3D and 4D design technologies like the Digital Factory Initiative are certain to play an important role in shaping that future.
Illustration #1:

2002 Market Segment Mix

- Industrial/Automotive (International): 3%
- Educational/Institutional: 10%
- Other: 1%
- Personal Goods/Pharmaceutical: 1%
- Urban Design/Planning: 7%
- Commercial/Financial: 3%
- R&D Technology: 5%
- Health Care: 25%

Industrial/Automotive (Domestic): 45%

courtesy of AKA, inc.
Illustration #2:

OLD = 60 month product development cycle

- 60% of development time to establish factory requirements
  - 36 months
  - 24 months

  Design
  - 8 months

  Construction time
  - 20 months

  Design & construction
  - 28 months

NEW = 30 month product development cycle

- 50% for requirements
  - 15 months
  - 15 months

  Design
  - 6 months

  Construction
  - 12 months

  Design & construction
  - 18 months

Comparison of Old (60 month) and New (30 month) automotive product development cycle’s impact on a typical Factory construction schedule
Illustration #3:

Illustration of information flow and various software utilities used in Frank O. Gehry’s Experience Music Project—from Martin Fischer’s “4D CAD Research”—Center for Integrated Facility Engineering, Stanford University
Appendix #1:

Albert Kahn Associates, current firm profile:

Today, Albert Kahn Associates pursues a strategy of differentiated service operating primarily in the Industrial, Health Care, Institutional and Office segments of the A/E industry. (existing Market Segmentation diagram to follow)

AKA’s current Generic Strategy:

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AKA is an employee-owned corporation with a current staff of approximately 300 consisting of over 120 licensed architects and engineers. In 2002 they were involved in over $1 billion in construction projects. Their staff breakdown in 2002 consisted predominantly of architects (76) with mechanical engineers (42) electrical engineers (22) project managers (21) and structural engineers (15) rounding out their professional staff.

The corporate structure of the firm consists of Albert Kahn Associates, Inc. which provides their core Planning Design and Management services, and its subsidiary: Kahn Global services Inc. which consists of 5 subsidiaries of its own: Kahn Solutions for Business, Inc., Kahn Program Management, Inc., Kahn Manufacturing Solutions, Inc., Kahn Professional Resources, Inc., and Kahn do Brasil, Ltda..

In 2002 AKA’s distribution of Business Segments was reported to be:

- **Industrial / Automotive (DOMESTIC):** 45%
- **Health Care:** 25%
- **Educational / Institutional:** 10%
- **Urban Design & Planning:** 7%
- **R & D technology:** 5%
- **Commercial / Financial:** 3%
- **Industrial / Automotive (INT’L):** 3%
- **Other:** 2%

For updated firm information, see:

[www.albertkahn.com](http://www.albertkahn.com)