# Rotation, Repetition and Refinement

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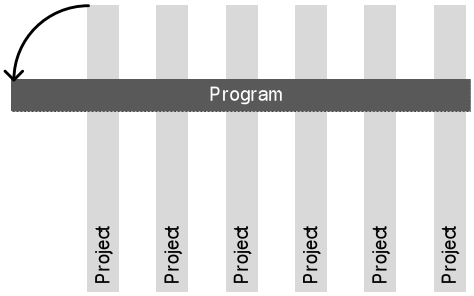
# Rotation Repetition and Refinement

*Summary: Program managers have an opportunity that project managers don't have. They can examine their individual projects to find similarities. When there is a similarity, they can rotate the similarity from the project workflow to the program. Then there is an opportunity for repetition instead of reinvention on every new project. Most important, they can improve across multiple projects. The results can produce enormous benefits in time, cost and quality.*




*Rotation is a term used to describe the process of turning a custom, project-oriented activity into a continuous, program-oriented standard. Standard processes, standard products and standard human participation save time and money. But standards shouldn't be static; they should be a platform for continuous improvement.*

*People do better work as they gain experience. They improve their processes, their work products and the buildings. And the people themselves get better.*

*The amount of rotation, repetition and refinement that can be achieved in a program is a function of the number of projects, the similarity of the projects and the authority of the program manager to enforce standards and push improvement.*

*The 3 Rs require:*

1. *Analyzing projects in a program to identify the similarities*
2. *Choosing the similarities that are the most repetitious and offer the greatest possibilities for standardization and continuous improvement*
3. *Focusing on ways to improve these standards at the program level*

*We make mistakes the first time we do things. We get better with practice*

Think how poorly you perform when you do something the first time. It doesn't matter whether you try to hit a golf ball, play chess, play a musical instrument, work quadratic equations, lay a brick wall, ride a bike or design a school? How did it go?

When we do things the first time, we are awkward and we make mistakes. As we practice, we learn and get better. Compare your first performance to what happens when you are experienced. Think how that level of improvement might apply to design and construction.

First, just getting right each time takes practice. Every golfer's dream is a repeatable swing. And every golfer knows you don't need great shots to shoot great golf. You only need consistency. All you need to do to shoot par is to hit good shots—every time. So good golfers practice their swing endlessly. With repetition, improvement can be enormous. It would take me half an hour to change a tire. With a little practice and a little technology, a tire shop can do it in a few minutes. With the pressures of competition, a pit crew at Indianapolis can change four tires in a few seconds.

*Improving one process stimulates improvement in related processes*

That's an enormous improvement. It takes about 500 times longer for me to change that tire than it takes the pit crew. Are there tasks with 500X improvement potential in project delivery? We think so.

Furthermore, If you improve a process, it stimulates improvement in related processes. When the tire changers in the pit crews at Indianapolis began to finish before the tank fillers, the tank fillers had to devise a faster way to fill up.

Consider a single project. Usually experienced people do the work. Someone who has drawn door details before draws them this time. But they're slightly different. And someone who has laid bricks before lays them this time. Typically, there are small, arbitrary differences from the last job for every task.

There's another issue. The team changes with each new project. Some of the people have never worked together. And, inevitably, not only are the tasks unique, the sequence of assembling them is unique.

There's lots of downtime sequencing different groups in and out of the project. The uniqueness of the project, much of which is arbitrary, results in inefficiency and mistakes.

Of course, every project has unique parts. Bad things happen when a standard is applied to a non-standard requirement. However, within any program there are always similarities. They exist in the need for similar services, in similar processes and in similar products that are used to make the buildings. The challenge is to find the similarities and to eliminate arbitrary uniqueness. But at the same time, it's essential to ensure unique results when there's a unique requirement.

*Every project has unique parts. It's bad to apply a standard to a non-standard requirement.*

When we talk about rotation, owners or facilities managers often respond that it won't work for them because they must build different buildings. So, let's get this notion out of the way. Capturing the benefits of rotation does not require designing a prototype and plunking down cookie cutter replications.

In fact, in our experience, in all of our research—and in just looking around us as we drive through our communities—we found few cases where serial builders could use prototypes.


*I'm sure the design team for McDonald's didn't have an adobe aesthetic for Santa Fe in mind when they conceived their prototype. But even the most common and ubiquitous prototypes are often modified to adapt to community requirements, indigenous aesthetics or unusual sites.*

Of course, there are some. The fast food and big box retailers create prototypes and constantly work on the designs. Some create a prototype and roll it out for a number of editions. Then they develop a new model—similar to the automobile industry. Others just improve continuously. But even the owners who build the most common prototypes find that they must frequently modify them for unique conditions—like the Santa Fe edition of a McDonald's in the margin.

So there is a spectrum. At one end are the clients that can work with prototypes. At the other end are clients, like a municipality, with a program of different building types—perhaps they must build a police station, a firehouse, a library, an administration building and a golf course. But even at that extreme, there will be many similarities in process, in the products and systems and in the people who execute the work.

We all grew up doing individual projects. The project mentality is strong in our industry. In our interviews with serial builders, we found many that continued to treat each project as an intellectual stovepipe that had little intersection with other projects. They had not made the mental adjustment to program thinking. They were still thinking project. So when we got the typical response of *"all of our projects are different,"* we always took it as a challenge. We drilled down in the conversation. As we did so, it became clear that all the

programs we reviewed had many similarities among their projects that were reinvented repeatedly.

## Rotation in industry

While we think about rotation, repetition and refinement, it's worthwhile to consider how rotation has occurred in other industries. Indeed, entire industries have rotated and capitalized on the repetition and refinement that became available.

Consider the automobile industry a century ago. Originally, a single team led by a master mechanic assembled an entire car. The car stayed in one place for most of the assembly and the workers moved back and forth getting and attaching parts. Just like a construction project, some stood around and watched while others did something that had to be done first.

*After Ford rotated assembly, the Model T cost dropped to about $300.*

Henry Ford's Model K (the predecessor of the Model T) cost about $3,000. Inflation since 1913 is estimated at about 2,000%! That means that the cost of a Model K in 21st century dollars would be about $60,000 today. And it was a primitive machine: no starter, no top, no doors, no windows. Add the improvements and technologies that are part of a modern car and it might have cost half a million.

When demand for cars increased, there weren't enough master mechanics to produce them. So a few of the best mechanics designed a process and trained unskilled workers to do one step in the process. They rotated the assembly process—the workers did one job, stayed in one place, and the car moved down the assembly line.

The quality soared and the cost plummeted. After Ford rotated the assembly process, the Model T cost dropped to $300—10% of the cost of a Model K. That's a 10X improvement. And it was a better car.

Similarly, when General Motors acquired Chevrolet, Oldsmobile, Buick and Cadillac, GM rotated many functions (body design, engine manufacture, instrumentation) out of the individual companies and applied the best talents and manufacturing resources across all of the individual automobile companies.

*The computer industry is a spectacular example of rotation.*

One of the most spectacular examples of the 3 Rs occurred in the computer industry in the early 1980s. Before that time, IBM, DEC and a few other computer companies enjoyed dominance over a vertically integrated industry. They designed the computers, made their own memory, processors, printers and card readers. They wrote their own software, sold, serviced and financed their computers.

Then affordable personal computers exploded on the market and demand increased enormously. The entire industry rotated. Intel made processors, Microsoft made software, HP made printers, Asia produced memory, Dell assembled parts for highly specialized manufacturers in a well-managed supply chain—and so on.

*The cost benefit ratio in the computer industry has exceeded 10,000X.*

Again, the costs plummeted and performance increased. In 1978, the price of Intel's 8086 was 1.2 cents per transistor and $480 per million instructions per second (MIPS). By 1995, the Pentium Pro's introductory price amounted to 0.02 cents per transistor and $4 per MIPS. By the early 21st century, it was $.42 per MIPS. That's a three order-of-magnitude reduction. And if you want to go back to the first electronic computers and project forward another decade, you can get five orders of magnitude. That's a 10,000X cost-benefit ratio.

That extraordinarily rapid rotation nearly bankrupted the vertically organized companies like DEC and IBM. Compaq acquired DEC and was later acquired itself by HP. IBM restructured and sold services to its traditional customers to help them integrate the myriad products from multiple horizontal producers.

Of course, those industries produce highly similar products. It's unlikely that the construction industry will rotate to the extent that the automobile or computer industry did—at least not in the near future.

*The Koreans and Japanese dominate the ship building industry. They lowered cost 20% and shortened schedules 30% by creating a database of standard components that could be assembled into custom-made ships.*

Perhaps a model that's more relative to the U.S. construction industry is shipbuilding. The Construction Industry Institute, easily the country's most respected construction think tank, funded a study on the global ship building industry. Essentially, the Japanese and Koreans dominate. They have dramatically reduced cost and schedules by creating an "interim database" of standard ship "building blocks" that is complete with construction details and supply chain information. These building blocks are components of workflow that have been rotated from the world of custom construction. They can pull those standard building blocks (along with sourcing information) from that interim database. They then can shape them into a custom design and deliver results for about 20% of the cost and in about 30% of the time that the U.S. and European shipbuilding industry takes.

*Rotation increases with similarity and multiple editions and when leaders want to capitalize on specialization, economies of scale, consistency and continuous improvement.*

That's about a 5X improvement. There's a principle: production of a single product is a linear activity. As the number of reproductions increases, many project tasks, many products and many services can rotate into the program and be made available to individual projects without the need for re-invention or re-sourcing. The potential for rotation increases with the similarity and number of editions and

when the producer wants to capitalize on specialization, economies of scale, consistency and continuous improvement.

The construction industry is rotating in baby steps. But it is happening. Drive through any city in America. Clients with multi-building programs build courthouses, schools, hospitals, hotels, colleges, fast food restaurants, grocery stores, universities and retail chain stores. Some of these clients are changing the way the industry works.

As our economy becomes global, corporations, institutions and even governmental entities are consolidating operations. Some have prototype buildings; some standardize systems and products; others build unique facilities but standardize processes. We're moving from a project-oriented industry to a program industry. The owners of construction projects have construction professionals on their staff who are unbundling the project delivery process and rearranging the parts.

*Organizations are getting larger; they have continuous building programs. They add construction professionals to their staff to manage their programs. Our clients are now construction professionals.*

## Three categories of rotation

When I try to develop an orderly way to understand a subject, my first inclination is to set categories—buckets to receive related information. This matter of rotation is no exception. The best way to understand rotation opportunities is to categorize them into three broad groups.

**People (services)**

Owners hire construction professionals to manage their building programs—either as an outsourced program manager or as internal staff. Then they may hire AEs, CMs and consultants to work on multiple project assignments.

**Process (activities)**

Then the managers develop and standardize approaches to hundreds of procedures like team selection, approvals and communications.

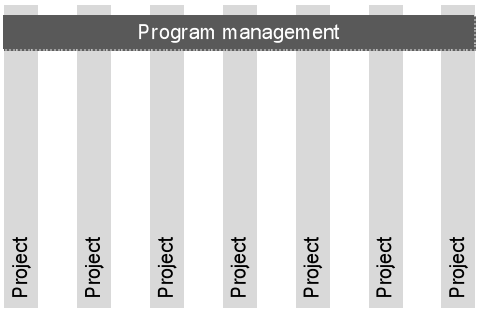
**Products (building systems and materials)**

Typically, the third step is to standardize products such as equipment, building systems, functional layouts and sometimes prototype buildings.

Let's examine these categories in more detail.

## People

Think of CEOs who are faced with building programs. They quickly learn that dealing with AEs and CMs takes time. They recognize that they can't manage design and construction and run their organization too. So the first thing they typically do is appoint someone to be in charge. They believe there will be better results with management continuity overseeing the projects—and if they have a manager who is a construction professional. Then the person they appoint to be in charge builds a team—either with new employees or with outsourced companies. Program management emerges.



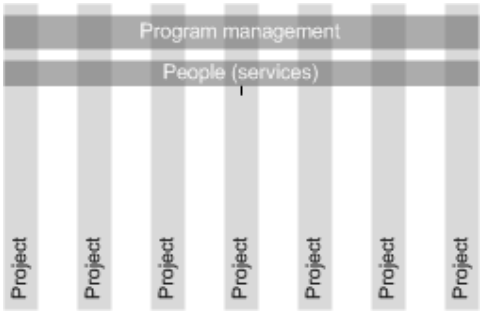

*The first thing an organizational leader who has a building program typically does is to appoint someone to be in charge. A program management function emerges.*

Management is the first rotated activity. People are rotated from an individual project workflow into a multi-project program workflow.

Here's a striking bit of evidence that supports the value of "rotated" continuous management. The FMI/CMAA[1] Seventh Annual Survey of Owners indicates that organizations that use a consistent management team (either in-house or outsourced) tend to lower their management cost by 30%.

A valuable body of institutional knowledge grows. The sum of the program experience accumulates in the heads of team members and improves their judgment. It can't be replaced by documentation and databases (although those things help).

Then the program management team begins to see that continuity provides value in other professional services. There's always a need for the same kind of brainpower and task execution on project after project. So they rotate many of the professional services required to execute the work. They may staff these services internally or hire organizations with evergreen contracts to work on multiple projects.




*Continuity provides value in other services. So Program Managers rotate many of the professional services required to execute the work.*

Perhaps, at first, they only stick their toe in the water and choose to do something simple like contract with one testing and inspection lab for all their projects. Or they may add other consultants such as roofing and wet-proofing, security, landscaping, data distribution, etc.. Or, at the other extreme, they may put together an entire design team for all their projects.

There are some heroic-scale examples. Parsons is managing design and construction for renovation and new construction for the U.S. Post Office nationwide. Bovis Lend Lease did the same for British

[1] FMI is a large management consulting company that focuses on the construction industry, and CMAA is the Construction Management Association of America. They collaborate annually on a survey of owners with continuous building programs.

Petroleum worldwide. During our research, we met BSW, an AE firm working on its 4000th Wal-Mart.

Hiring a single AE to design multiple projects is an economical thing to do and it will provide the opportunity for continuous improvement. But that's easier for private clients than for public clients who must spread the work to different firms in their constituency.

But hiring individual AEs for each project doesn't close the door on rotating services. AEs use a large set of specialty consultants. They must pass the cost of these consultants on to their owners as a reimbursable cost or include it in their fee. Most of the subject matter these consultants work with has program-wide relevance.

*AEs, like GCs, have a surprising number of specialized subcontractors.*

AEs are becoming more and more like general contractors that subcontract most of their work. AEs now have a surprising number of specialized consultants. They include roofing and wet-proofing, audio visual, data and communications, security, life safety, accessibility, sustainability, commissioning, testing and inspection, furnishing and equipment, acoustics, lighting, food service, landscape architecture, graphics and signage, civil and geotechnical engineering, transportation, parking and traffic engineering, interior design, design, hardware and locking and so on.[2]

*Many of the subconsultants that AEs use should be program-wide consultants.*

Owners can rotate these consultants. The consultants can be hired by a project-specific AE but be an owner's specified consultant and have program-wide responsibilities. The consultants can develop standards and prepare basic specifications and prototype CAD drawings on their first project for their normal fee. Then those standards and specifications can be provided to each subsequent project team. The consultant can review those subsequent projects for a much smaller fee. What's more, the consultant can review the results and improve the product with each subsequent project.

To illustrate this concept, let's take roofing as an example.

In our condition assessment work, we've walked through about 2 billion square feet of buildings. The most common problems are caused by water. It seems that in 4,000 years of architecture, we still haven't learned how to keep the water out. It's hard to think of anything in the world of facilities that deserves more attention for continuous improvement.

[2] Of course, not all of these consultants are required on every project. While all of them will have a roof, not all will have food service.

Now let's assume that the Program Manager selected the best roofing and wet-proofing consultant to be an "owner-nominated consultant." The roofing consultant would earn a full fee on the first assignment. It would be a reimbursable expense in the AE's fee. The roofing consultant would prepare specifications and drawings of standard roofing and flashing details. That package would then become the standard for that system.

Then each time a new project emerges with a need for that roofing system, the consultant would provide the AE with the standards, answer questions and review drawings. The fee for the repetitive service would be about a third of the full fee. [3]

*Rotating consulting services would save significant amounts of the consultant's costs.*

Rotating this consulting service would save two thirds of the consultant's cost after the first project. And it would increase cost predictability and shorten schedules a bit because the details are standard.

Moreover, there should be continuous improvement in the roofing system—with a review of the standard details after each installation. There should be reduced maintenance cost and fewer errors. We might even have a roof that doesn't leak.

Of course, there can be variations on the approach. If there's political pressure to spread the work around, the owner could hire two roofing and wet-proofing consultants—one for flat roofs and one for sloping roofs. The economies would be the similar.

That's about a 3X improvement. Similar approaches can be used for other consultants.

*Most things cost less in larger quantities.*

Owners can usually get a better deal when they buy things in larger quantities. But the economies of scale are usually greater in the procurement of services than products. Buying windows for a dozen projects might save 10%, but buying the design will save a lot more than 10%. If one can develop a good idea, the implementation of individual editions may cost little or nothing.

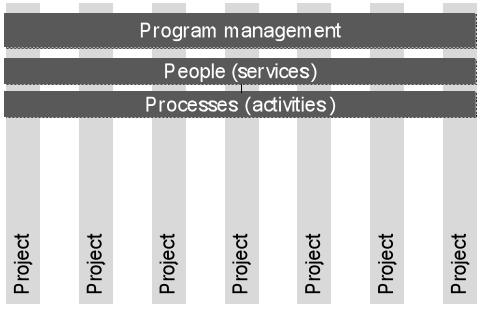
Buildings are the only common product in our economy that usually must suffer 100% of the design cost. If the design cost of an iPod had to be amortized against a single unit, the price would be prohibitive, and we would all be poorer for it.

[3] In estimating this cost reduction, we spoke to Fred King at Inspec, Inc., a large and (in our opinion) highly competent roofing and wet-proofing consultant. Inspec provides services for the Minnesota Colleges and University system. Other consultants may work with other fee schedules but the conclusions will be the same.

When we deal with an individual project, it's hard to have the time and money to study many alternatives, research many practices and polish many processes. However, a Program Manager can amortize such an effort against multiple projects and reap the benefits repeatedly.

## Process

Try this. Select several projects from a multi-project program. Diagram the design and construction activities. You will uncover many repetitive processes in contracting, requirements setting, communication, decision-making, documentation, approvals, controls and so on. Since so many people are involved in delivering a building, designing a process for engaging the entire team—communication, collaboration, planning and forming agreements—is as important as designing the buildings.




*There are many repetitive processes in contracting, requirements setting, communication, decision making, documentation, approvals, controls and so on.*

So, in thinking about these repetitive processes, we asked ourselves if there were tasks we could rotate that would produce the 500X benefit ratio that the tire change example produced.

Here is one—a practice that many good program owners have already adopted. Normally it takes weeks, perhaps months, to negotiate a contract for design. The owner's protective lawyer meets with the AE's protective lawyer. Each represents its client's potential risk—and, to be a little cynical, each is paid by the hour. They argue their points and then schedule independent interim meetings with their respective clients. Changes must travel through bureaucracies. Multiple meetings suffer the delays of calendar conflicts.

Some owners solved that problem by meeting with their service providers and developing fair standard contracts. They include them in their RFPs and ask responding firms to note objections. That feedback produces continuous incremental improvement in the baseline contract. Assuming the contract is fair in the first place, the final contract gets signed without a meeting. That process helps the project schedule as much as HEB's standard bar joist. That may be about a 500X improvement.

Serial builders usually develop project delivery processes that vary from industry standards. (Industry standards for project delivery are vanishing anyway.) Good Program Managers understand that to get people to work together effectively, they must set a clear vision, develop tools to extract the intellectual capital of specialists, install systems of information dispersal and find clear ways to describe the processes that must be followed for the hundreds of people who have to work together.

Program Managers need processes to make sure everyone knows what to do. In the 1990s, our company developed an electronic, web-based policy manual that we could customize for each client. It had on-line forms and instructions for many procedures. A contractor could go on-line and read the instructions for billing the owner. Then the contractor could fill out on-line forms for the money due. Many other organizations have done the same.

The art of getting information up front and defining a project quickly is a clear example of important process improvement. Hines Interests has built hundreds of office buildings throughout the world. The Hines people hire internationally famous designers because they believe that creative, unique, world-class designs attract top-tier corporate clients as tenants.

Hines has arguably built more fine architecture than any owner in the world. If you look at a collection of Hines office buildings, they all look different. Nevertheless, despite the unique appearance of the buildings, there are many similarities that Hines has refined over the years. They're likely to have the same five-foot module. There will be MEP systems, ceiling lighting systems, elevators, doors frames, structural bays, hardware and so on that they have used before and are refining on one more job.

*All the Hines office buildings look different. Nevertheless, there are many similarities in the building materials and systems that the Hines organization has refined over the years.*

There may be several different choices for each system with different price tags depending on the potential tenants and the location. When Hines starts a project, there is a five-page checklist of choices that includes things like finishes in the toilet rooms, MEP systems, lobby height, elevator finishes. Jerry Lea, who leads the conceptual design group, makes decisions on these items with the AE team in the first few weeks of the project and refines the list on every new project.

Hines also uses a submittal review process that saves lots of hassle. Just before the start of construction, Hines holds a submittals workshop. Typically, submittals trickle in over the life of a project. They delay the work because they're never first priority for anybody. Then, at the last minute, before an order must be placed, someone finally gets around to reviewing the submittal. And guess what? The submittal gets rejected. That precipitates several meetings to resolve the issue. With calendar conflicts, it takes weeks. So the project schedule is blown. Hines does it all at once before the project starts. They bring in the AEs and the key subs and review everything at one sitting.

Here's another example of product rotation. Rice University has rotated the aesthetic concept of the ultimate product—the building. The original design concepts were set by Cram Goodhue and

Ferguson. Ralph Adams Cram led the assignment and invented an architectural style for the school. The architecture is frequently called Neo-Byzantine or Byzantine Romanesque. It is unique and it reinforces the vision for the school.

Stephen Fox, an articulate historian on the Rice faculty, describes the beginnings of Rice:

> *"The architecture of Rice University represents an extraordinary assertion of will. It was designed to represent the identity of a cultural institution that, because it was newly created, had no identity."*[4]

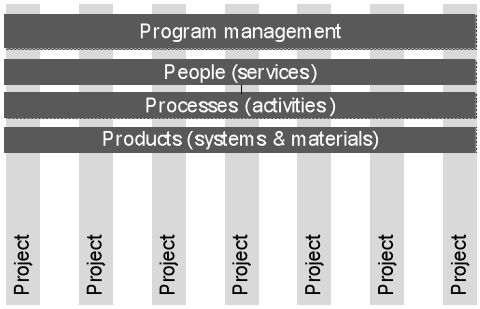
The point is that the architecture, as a representation of the new University, helped define the University. Although today Rice works hard at choosing world-class architects for the campus, Rice asks them to maintain aesthetic continuity with the original design. Nobody has to spend time deciding on materials and the visual vocabulary.

*Rice University has rotated the esthetic concept of the ultimate product—the building. Lovett Hall (above) was built in 1917, Baker Hall (below) 80 years later.*

The University of Texas at Austin also has a grand architectural tradition set early in the 20th century.[5] The University has wisely decided that the architectural heritage is a valuable asset and should be preserved. So the University asked Cesar Pelli to develop a manual of aesthetic design guidelines. Providing architects with these guidelines accelerates the design process and improves the aesthetic qualities of the environment.

## Product

If programs are thought of only as a series of individual projects, each project is a separate intellectual smokestack executed by a separate team. One project fails to inform another. Sometimes the AEs produce good results; sometimes the next edition, done by a new AE, is not as good as the last. Always there are some good ideas that are not replicated and some bad ideas that are.




*Although the buildings in a program may each be unique, many requirements will be common and many products may be used for multiple projects.*

Even though an owner may require buildings with unique designs, hundreds of functional requirements will be common. For instance, an educational institution will want individually designed buildings for different disciplines (a math building, an English building, an engineering building, etc.). But the buildings will have faculty offices, classrooms, laboratories, toilet rooms and dormitories with identical

[4] Stephen Fox, *Rice University: an architectural tour,* Princeton Architectural Press, 2001. p. 2.

[5] Cass Gilbert, Paul Phillippe Cret, James M. White and Herbert M. Greene are widely considered the visionary architects who set the aesthetic style for the campus.

requirements. And building systems are repeated: roofing, AV, data distribution, MEP, lighting, etc.

Each of these similarities can easily be a continuous improvement program—increasing performance and decreasing cost.

The Program Managers can learn from the experience they accumulate. They can replicate the best functional layouts. They can refine building systems and choose equipment to minimize maintenance inventories. They can develop good architectural practices that are sustainable in a world of limited resources and increasing competition.

Most important, they can build each project on the last set of experiences instead of reinventing a new and perhaps lesser product.

The life of the administrators will be improved as well. If owners have functional baselines and building system standards, they won't need to fight political battles with their users for capricious requirements on every project. Cost control will be easier and owner-initiated change orders during construction will decrease.

*With standards, owners won't need to fight political battles with their users for capricious requirements on every project.*

On a large community college program we managed, the President felt obligated to hire multiple AEs because multiple firms had supported the fundraising programs. The plan was to hire one AE for each of the five campuses.

But after some thought, we realized that approach would have five presidents and their AEs competing for space, five different mechanical systems, five different kinds of faculty offices, five different kinds of classrooms and so on.

We suggested they hire one AE for "program definition" and then hire multiple AEs for execution. They took our advice. The Program Definition AE set finishes, accessibility standards, LEED requirements, IT communication guidelines, landscape and irrigation concepts, furnishing, fixture and equipment selections, security standards and an energy code.

Then the Program Definition AE established standards for lighting, acoustics, thermal and air quality and designed common, reoccurring spaces like faculty offices. As the program moved ahead, the project AEs established specific requirements for their buildings. It worked well.

Here's another example of rotation that works without prototype building design. Starbucks must build its coffee shops in unique locations—airports, office buildings, bookstores, shopping centers. We managed the construction of about 30 of these shops. We quickly

learned that no two could be the same—the shops went into different buildings. Occasionally Starbucks built a stand-alone building, but the shopping center design or whatever group of buildings that surrounded it would control the building design.

Therefore, Starbucks couldn't design a prototype building. But it could standardize the cabinetwork, equipment and finish materials. Starbucks bought these products in bulk, warehoused them and delivered them to construction sites. The standards saved design time, the bulk purchases saved money and the warehousing saved construction time. And they delivered a consistent environment that their customers came to expect.



*Starbucks can't design a prototype building. But Starbucks can standardize the cabinetwork, equipment and finish materials and deliver the environment its customers expect.*

HEB is a large grocery store chain in the Southwest and produced one of my favorite examples. Howard E. Butt[6] set a policy that his grocery stores must respect the aesthetics of communities where they're built. So they have unique exterior treatments. As usual in a steel frame design, the shop drawings preparation, shop drawings approval, fabrication, delivery and erection were critical path items. So HEB decided to use a standard structural bay and only one bar joist size. HEB bought several years of bar joists in an evergreen indefinite quantity contract. They saved a little on the cost of the joists but saved months in the delivery schedule.

Another grocery store builder, the Defense Commissary Agency, builds at military bases around the world. Most of the bases have design guidelines (called installation compatibility guidelines) that require different exterior materials, fenestration and rooflines. Each base is different. Moreover, some bases are bigger than others, so they need bigger commissaries.

Like Starbucks, DeCA can't build prototype buildings. However, it can design prototypical layouts, structures, MEP systems, cabinetry, shelving, refrigeration, checkout facilities, framing, etc. DeCA has eight prototype layouts that can be adapted to individual base requirements. A Facilities Standard Review Board re-examines and updates the prototypes. Ideas come in via a website and an on-line chat room. Often DeCA varies the prototype. A change might be adding a fish market in San Francisco or New Orleans.

Many Program Managers hire individual AEs for each project. If the Program Manager doesn't inform the design teams with program standards, the AEs will design the building from scratch. They will study basic questions such as lighting, HVAC and structure no matter how many times other AEs have settled those questions satisfactorily

*Many programs hire individual AEs for each project who then replicate each other's work endlessly.*

[6] Charles Butt (his son) is now chairman and carries out the same policy.

on previous buildings. Often there will be an old design that was better than the new design. That's not continuous improvement.

Conversely, many of the serial builders we interviewed built buildings with similar requirements and abandoned the thought that each should be unique. They design unique components when the requirements are unique. Then they use standards or try to improve on the last edition of a standard when the requirements are unchanged. Some have found ways to implement those standards with great efficiency.

The Los Angeles Unified School System has the largest building program in the United States.[7] LAUSD's policy is that their schools should fit into the architectural character of their communities. So each project is an individual design. And like many public clients, the LAUSD people feel they must pass work around to different architectural firms in their community. They also hire a few famous firms for trophy buildings.

In their first major round of school building, they gave the architects a loose-leaf notebook of instructions with three pages of general written descriptions of the characteristics of a good school.

In the next round of school projects, several years later, they included a CD Rom with specifications and CAD drawings of good examples of designs from the first round of designs that met those characteristics. The CD Rom included everything from good site layouts to well-designed library checkout desks.

*Buildings don't have to be prototypes to benefit from rotation.*

Lesson: you don't have to think of the whole building as a prototype to benefit from rotation concepts. There are many ways to increase productivity by rotating standards for parts of a facility—leaving other parts available to satisfy a unique requirement with unique designs.

## All together now

Often, if a Program Manager undertakes a rotation initiative, the chance of success increases substantially if all three categories—people, process and products—are synchronized in the effort, if all three are rotated together.

*The chance of success increases if all three—people, process and products— are rotated.*

If not, there is a chance of failure. For instance, the Air Force decided to do "definitive designs" for dormitories. The Air Force people felt that the requirements should be consistent across all their bases and that a standard design would make sense. So they hired an

[7] $19.2 billion as of 2007

AE, developed the design and sent it out to the bases. It gathered dust on the shelves. The bases hired their own AEs, who had their own ideas about what to design and build.

It would have worked if all three categories had been rotated at the same time and the following had been in place:

1. A policy with schedules to review the definitive designs as they were implemented (the process)
2. An enforced policy to implement the standard design (the product)
3. A contract for the AE of the standard design to oversee the site adaptation of the design (the people)

## Standards and improvement

The benefit of rotation is not only the cost and time reduction. It's also the increase in quality.

As we begin to answer the question "what can we rotate?" the inclination is to establish standards: a standard process or a standard product. GSA, with its enormous building program, has a large notebook of standards that they give to AEs.

But when I talk to designers about standards, I watch troubled frowns begin to appear. It's likely that the best and brightest AEs will cloud up. Their concern is that standards will build barriers to innovation or their own creative ambitions.

*A standard should be a "CWS" (a current working standard) that is subject to continuous improvement.*

The reverse should be true. An organization with standards should always view them as a "CWS" (a current working standard). A CWS is only there until someone has a better idea. But a standard eliminates the cost of reinventing wheels and reduces the possibility that the next edition will be worse than the last.

The culture of Program Management should encourage project teams to view standards as benchmarks: a platform for innovation and improvement. Standards are good but improvements are great!

The best of the serial builders don't leave their standards alone. They constantly tweak them. Meanwhile, if there's not a better idea, they apply the CWS to current projects and gain efficiency in the current project delivery. That's sure different than reinventing every part of every project.

Most construction programs have projects that are staged over a period of several years but must be done within budgets. If Program Managers build projects with similar standards, the cost will be more

predictable. Furthermore, Program Managers dealing with similar projects will find more economies.

The original cost of a facility is only a fraction (usually less than 10%) of the total cost of ownership. Post evaluation of energy consumption and operations and maintenance can be fed back into a continuous improvement program.

*How much would we save if everything were done right?*

I had a conversation with Barbara Bryson, who's in charge of design and construction at Rice University. Barbara is unusually skilled at keeping some of the world's best design architects within schedules and budgets. She constantly questions traditional processes and searches for improvement. She repeated a conversation with one of the senior administrators at Rice. He asked her how much might be saved if everything in the workflow were done right.

Who knows how much can be saved? Maybe 5% or 10%. Maybe more. However, we discussed a couple of refinements to the question.

*We make mistakes the first time we do something; we only get it right when we practice.*

First, as long as each project is a set of unique tasks, it won't all go right. We make mistakes the first time we do something; we only get it right when we practice.

Second, if we rotate tasks and focus on them, the first stage is doing it right. That might gain the 5-10% improvement. But with practice, and sometimes some new technology, we can produce enormous gains—radically exceeding normal expectations.

So the better question is, "How much can we rotate? And what savings will that rotation produce?"

*Must each building be a unique work of art or will we have better architecture with repetition and refinement*

Instead of designing a unique building with each assignment, can we have great architecture and still polish our work through repetition and refinement—making it better as we progress? We think so. And many of the people we talked to in researching the material for this book think so too. What's more, they're proving it by doing it.

## Barriers to rotation

*Tradition governs the relationships.*

Design and construction are traditionally project, not program oriented. Tradition is hard to change. Tradition governs the relationships among hundreds of organizations that are involved in a single project.

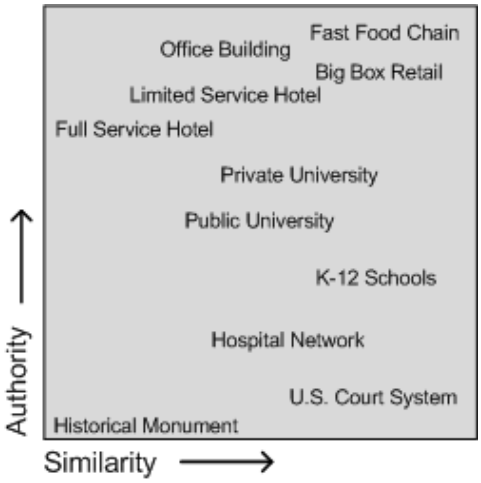
Saving time and money and implementing continuous improvement requires change. It takes authority to implement change.

No Program Manager is in complete control of the building program. (Indeed, there is never any one person in complete control.) A board,

users and administrators all exert influence. AEs have opinions. There are myriad entitlement agencies that present their wickets through which approvals must pass.

The ability to rotate people, process and product from the project to the program depends not only on the similarity of facilities that the organization builds; it also depends on the Program Manager's authority.

To implement standards and continuous improvement throughout a program, a Program Manager must have the authority to push change and enforce standards. Each project will be executed in a broad-based constituency of intelligent people with independent ideas. Clearly, no Program Manager will be able to prevail consistently. Strong people with capricious ideas or a whim of iron will cause variance from the standards. However, a Program Manager must identify those areas of continuous improvement he or she can affect, and perhaps be sanguine about the territory beyond his or her control.




One day, Sid Sanders sketched out a diagram similar to the box on the right. His point is that the degree of rotation is a function of the similarity of the buildings in a program and the amount of authority the program manager has.[8] In order to illustrate that point he drew this diagram and we filled it in together. Our assumption is that fast food chains and big box retailers have considerable authority over their projects and the facilities have similar requirements. So they can achieve considerable rotation. A developer of an office building may have a lot of authority but the similarity of the projects will be affected by local markets and land costs. A limited service hotel will have more similarities than a full service hotel. A historical monument is apt to have unique requirements and many groups of people affecting its design. The U.S. courthouses have similar requirements but the local judges control the design. The Program Manager of a theme park may have a high degree of authority but the building requirements will be unique.

## Rotation and design

A repeating message on these pages is that the first time we do things we make mistakes and perform slowly. Reliable and efficient results come from repetition and study. That inevitably triggers a concern

[8] Sid was then head of facilities for the University of Texas System. He is now Vice President for Facilities and Construction for The Methodist Hospital System, Houston, Texas.

among many architects who rightly feel that architecture is an art and each building must be an individual creation.

The tradition of architecture is that every building should be custom designed. It should respond to the uniqueness of its site and the context of the neighborhood. No firm should ever copy another—and not even repeat itself. Basic design decisions for lighting, HVAC and structure need to be freshly examined for each project.

That tradition permeates the profession. Unquestioned, it sets the attitudes of many clients. And, indeed, many projects *are* unique and call for a unique response.

But, with few exceptions, the world's most sophisticated clients have abandoned those thoughts.

The central question then is: "Instead of designing a unique building with each assignment, can we have better design by polishing our work through repetition and refinement—making it better as we progress?" We believe so, and we are seeing it happen.

*Talented architects can leverage their skills across more of our built environment.*

For many people who enjoy good design, there's a hope that talented architects can leverage their skills across more of our built environment. If Michael Graves can design tea kettles for Target, there is no reason not to have great architects designing great buildings for serial builders.

Whenever I am in Washington, D.C., I try to visit the Renwick Gallery. It focuses on exhibiting crafts. There was a show of "Studio Furniture" that included wonderful chairs by George Nakashima, Tage Frid and Sam Maloof. I admire these craftsmen and their work.

If you do that, you will have a wonderful, original, handmade product—but even at that price, it won't be completely unique. There are others similar to it. Although I am in awe of the exquisite craftsmanship and would like to have one, I ponder my conviction that none are as functional or as comfortable as the Herman Miller mass-produced Aeron chair designed by Bill Stumpf or the many chairs designed by Charles Eames. Nor are they more beautiful. However, they sure are more expensive.

*During the 20th century our art forms became repeatable.*

Here is the arresting thought: during the 20th century, our art forms became repeatable. Stage performances became cinema; paintings became prints; and music and photographs are now commonly duplicated. Maybe in the 21st century architecture will achieve that distinction.

Clearly, no organization adopts every useful innovation that's available to it. While some quickly recognize opportunities for improvement and have the authority to cause change, most do not. It's understandable. There're lots of people involved in a building program. Regulations abound. Big money is involved. And these programs typically serve organizations with bureaucracies that don't understand construction and are inherently conservative. So it's hard to improve.

And so we are antiquated. If the construction industry had had the same increases in productivity as the rest of the U.S. non-farm economy has had since 1864, we would need less than half the people and we could build for less than half the cost.

Productivity is increased by applying technology to repetitive tasks. The reason the construction industry has not improved productivity is that it produces unique, labor-intensive, custom-made products.

The great promise of program management is the opportunity to choose repetitive tasks, figure out how to do them efficiently, standardize them, improve them relentlessly, apply selective technology and make dramatic improvements in production.