HIGH PERFORMANCE FACILITY SYNCHRONIZATION

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Abstract

Designing a facility today requires a more comprehensive and holistic view of a building's performance systems and their interrelationships. The systems' ability to interact and respond to change can either hinder or enhance the facility in becoming an enabler for reaching constantly changing workplace objectives for organizations. The challenge is to evaluate and select the design alternative that synchronizes facility performance with these business objectives and justifies its required financial investment.

"High Performance Facility Synchronization" is an alternative design process that responds to the challenge of meeting the increasing demands of the workplace and the facility that supports them. This new approach addresses:

- Accelerating trends in employee demographics and technology that affect the way work processes are changing.
- A facility's performance systems to satisfy the increasing demands of workplace performance criteria.
- The financial and qualitative benefits resulting from a comprehensive and collaborative approach to design and construction.

High Performance Facility Synchronization

Although there has been some improvement in recent years in solving the numerous challenges that office design professionals and facility managers continue to face, there is still a need to improve both the design process and quality of the office environment. Many of the complaints of occupants in the corporate workplace persist, such as thermal comfort, air quality, adaptability of the space to respond to constant change and financial justification of space improvements to enhance collaborative work and productivity. The "intelligent" buildings concepts of the 1990's help, but facility managers are still left with high costs for departmental and individual moves (churn) and continue to deal with large amounts of outdated or abandoned embedded technology. As manufacturers of all types of products and systems become more effective at introducing innovative ideas, they risk not reaching their full potential if, when considered or implemented, they are viewed in isolation of the many other potentially interrelated components in a facility.

A solution to this problem, created by the conventional way of coordinating and assembling many independent building components individually, is to design a high performance facility synchronized as a total system. Cost is always a concern and often inhibits better up front design solutions; however, it can be illustrated that a company can derive significant financial benefit from the High Performance Facility Synchronization approach. When performance, life cycle costs and tax advantages are taken into consideration, a better corporate value versus the first-cost advantage of many conventional construction solutions will result. Although this approach takes more up front collaboration and planning, the benefits are not only financial but also conclude with a facility that is more adaptable to change and that provides improved worker comfort and increased productivity.

Some of the main issues High Performance Facility Synchronization addresses are:

- Workplace Optimization
  - work process and productivity of the knowledge workforce aligned with corporate objectives

- Connectivity and High Performance Building Systems
  - data, power and voice, air quality, thermal comfort, lighting

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- Security
  - site, building, workplace air filtration

- Flexibility and Adaptability
  - readiness of facility to respond to changing business requirements

- Financial Justification
  - investment returns, tax advantages, life cycle cost

- Sustainable Design (i.e., LEED – Leadership in Energy and Environmental Design)
  - employee welfare and comfort, sustainability, energy optimization, and site management

Before one can look at how to design facilities with a new approach, one needs to understand the factors that have impacted business over the past few years. These include the trends of:

- Mergers & Acquisitions
- Real Estate Investments
- Organizational Change
- Technology
- Workplace Productivity
- Workforce Attraction and Retention

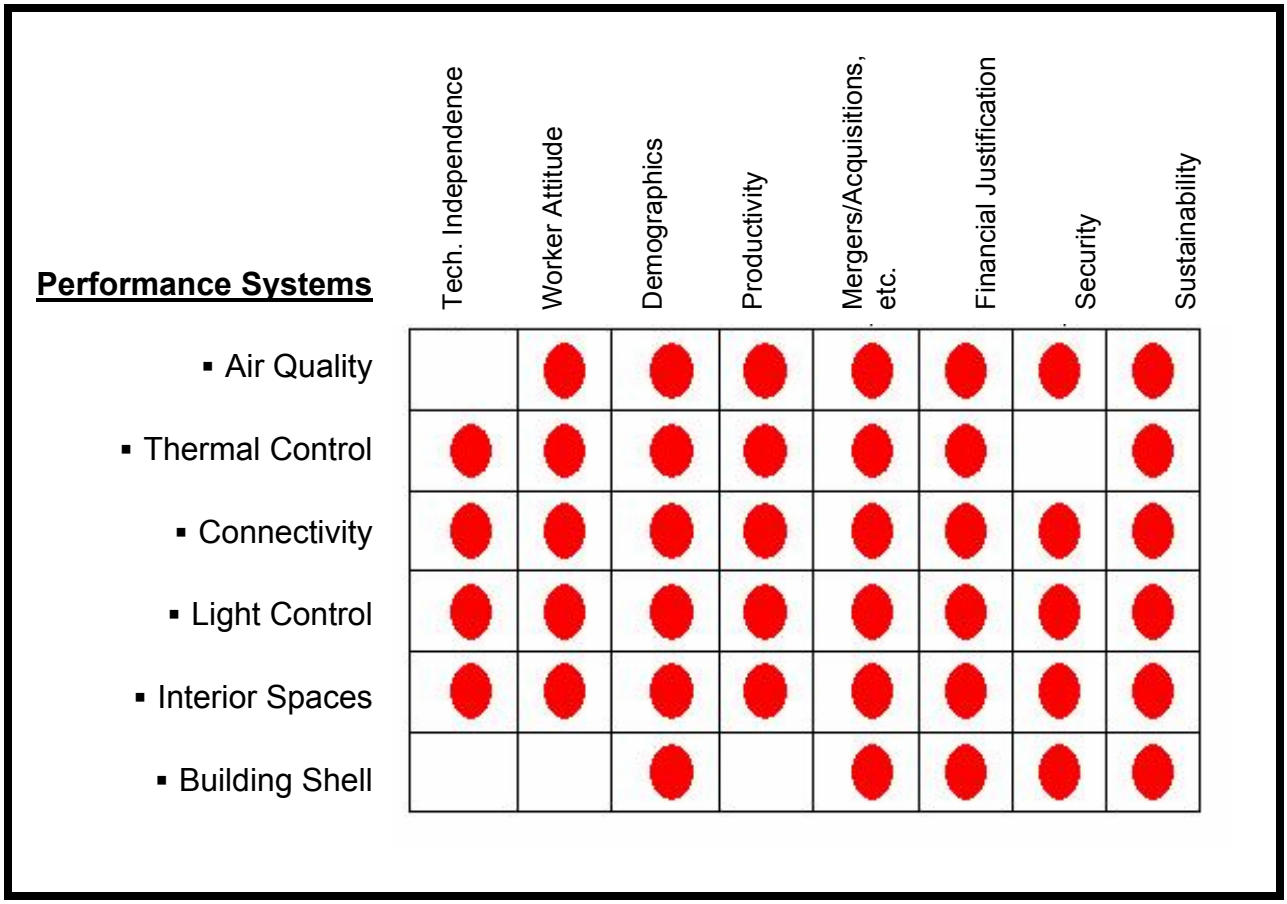
Diversity, along with generational attitude in today's workforce, are two other key factors that should be considered when designing our facilities. Current drivers such as the rate of technology independence has enabled employees to be able to work anywhere, anytime. This influence has allowed companies to take a second look at their real estate and make smarter decisions on their investment strategies. In the wonder-years of the 90's when it was hard to find good employees, workforce attitude gained traction and corporations that were in search of the best began to add facility amenities in order to attract and retain their intellectual capital. The demographics of the workplace have changed over the years and organizations have flattened. The Knowledge Worker has become the core of the organizational structure, gaining force in numbers and influence. This has created changes in facility design as their work needs and balance-of-life issues have become more critical. Mergers, acquisitions, and "right-sizing" all have become second nature in today's world. Corporations have become dependant on the productive nature of their teams to create new product and to bring the organization forward. The old predictive models often do not work today, while more emphasis has been placed on financial justification before projects begin. Security issues influence where our industry builds and how our industry builds - not only in terms of the physical impact, but from a technological impact as well. Resources are running dry and becoming expensive, too. Designers need to turn to better ways to save energy and make sustainable choices for the future of the physical environment and for our world. All of these critical workforce drivers need to be considered during the facility design process.

There are also several hurdles or restraints that organizations may face when contemplating a new, holistic approach to facility design. One of the common restraints that the facility manager has to overcome is the "first-cost mentality." If it costs more to initiate a new way of working or a new way of building, then why do it? Illustration of cost savings over time may still not be enough to get decision makers to try something new. Other restraints may be in how to deal with embedded technology, outdated standards, corporate readiness for change, and outdated regulatory codes. If "we've always done it this way," how can one effectively justify change?

By understanding the past, realizing the reality of the present, and facing the challenges that can come along the way, one can be better prepared to embrace the future approach of facility design.

High Performance Facility Synchronization is a potential alternative answer to complex design and facility problems. It is defined as a synchronized network of building systems aligned to the objectives of the enterprise versus the conventional approach of just coordinating different facility components. The matrix and illustration on the following page is a sampling that shows how some of the current drivers previously mentioned are impacted by facility performance systems:

Current Drivers



The table on the next page illustrates a few examples of building concerns or needs, the systems that would be involved, and how the High Performance approach to these challenges differs from a more conventional approach:

Building concerns or needs	Systems involved	Conventional office building thinking	How a high-performance synchronized building can help
Chemical sensitivity, mold, security	Air Quality	Focus on mechanical equipment first cost; minimal emphasis on office air quality	Emphasis on controlling humidity, filtration and providing fresh air to the office environment
Greater control for individual, team and group comfort recognizing personal preference and the need for constant change in the workplace, more flexible collaborative work settings	Thermal Control	Responses to problems are complaint-driven, companies often focused on initial costs with less zoning capability and flexibility to adapt to change in space configuration and use	Establishing greater zonal distribution with individual and group control wherever possible
Flexibility and accessibility	Connectivity	Technology is embedded and centrally located	Wireless, modular options and plug and play capability distributed through the space
Flexibility for individual and groups tasks, exposure to natural light, energy savings	Light Control	Use a standard lighting system with minimal zoning and focus on first-costs; general illumination not work process focused	Establishing zonal distribution and controls, lighting that is not hard wired, and utilizing ambient and natural light for individual and group needs. Address energy and tax savings
Optimize flexibility in the workplace; facilitate technology and cultural change	Interior Spaces	Interior standards are based upon hierarchy or universal plans; metal stud and drywall partitions	Design of office spaces that support work process and allow for flexibility to respond with low cost churn and remodeling; movable partitions
Security, energy efficiency and image	Building Shell	The shell is designed independently from the interior building systems	Integrating internal systems with external shell allowing greater effectiveness/flexibility and energy savings

When designing facilities utilizing High Performance Facility Synchronization, numerous components under each performance system can be evaluated simultaneously. Although there are many new systems, materials, and workplace issues to consider when approaching facility design in a synchronized, holistic approach, the following are additional examples of the key components:

- **Air Quality** systems that address the concerns of employee health, safety, and comfort by providing filtration, ventilation, and humidity control. This could involve increasing the level of filtration to remove mold, pollen, dust and pathogens or the ability to add microbe killing UV light at air handlers or simply involve a more careful selection of finish materials that emit fewer chemicals.

- **Thermal Control** systems that provide enhanced individualized control to respond to ever-varying demands for heating and cooling. Instead of a complaint-driven response to problems, the synchronized workplace utilizes a matrix of zonal distribution and controls to provide adaptable thermal control at a reasonable cost.

- **Connectivity** for voice, data, and power systems can generate great stress to the knowledge workplace. Embedded technologies inhibit flexibility and reliability in the familiar examples of abandoned cabling, excessively core-drilled floors, and outdated infrastructure. Adaptable office facilities can be designed and cost justified that provide wireless and wired options with access to the infrastructure that is non-disruptive to ongoing workplace.

- **Light Control** can provide flexibility for individual and group tasks. Instead of a standardized lighting system, which is typically focused on minimizing initial cost, the high-performance synchronized facility employs a system of affordable and cost effective zonal distribution and controls. When feasible, adaptable designs take advantage of natural light and integrate it with the general ambient lighting to maximize energy efficiency and enhance the qualitative aspects of the workplace. Task lighting can then support more individualized performance needs, where and only when it's needed.

- **Interior Spaces** are trending toward more manufactured components that offer a greater opportunity for achieving workplace adaptability. For example, demountable partitions have improved dramatically in quality and appearance in recent years. Although a higher first cost, they offer substantial schedule and cost benefits when adapting the office space to address change with minimal down time.

- **Building Shell** is a key component for consideration in high performance facility synchronization. Access to natural light - or the lack of it - contributes to or detracts from the overall quality of the space. The design of the building shell can also contribute to air quality, thermal control, and better connectivity and is a key component in energy conservation. The building shell is also the first line of security for employees.

There can also be other benefits to designing a high performance synchronized facility:

- **Expense Reduction** – maintenance, churn, operations, and utilities.

- **Property Value** – reduced obsolescence, improve life cycle costs, and exit strategy.

- **Workforce Appreciation** – attracting and retaining talent, less absenteeism.

- **Business Objectives** – scalability to meet demands (mergers, acquisitions, downsizing), flexibility to reconfigure space based on changing work processes.

High Performance Facility Synchronization begins with the design team and client working collaboratively all the way from pre-design to post construction. Design processes are established t0 assure architects, engineers, interior designers, vendors, contractors, and the client are in constant communication. A detailed process map has been developed to help organize the numerous activities and tools that have been generated - ultimately enabling the team to meet critical milestones and achieve optimum results. Many material and systems alternatives are considered in this holistic approach, looking at their impact or feasibility with respect to several building systems. Typically, with the past conventional approach, these products or system alternatives would not have ever been considered, utilized or made any impact on the ultimate decision.

One of the main evaluation methods utilized on a High Performance Facility Synchronization project is to perform cost/savings comparisons of the alternatives and study their impact on different building systems. A base system is typically selected (often the lower first cost) and compared with what is considered to be a synchronized system improvement. However, alternatives are also studied that may not be considered improvements but have a positive impact on other building systems or improved overall facility performance. Net present value calculations are run separately for different time periods and criteria (i.e., frequency of remodeling anticipated, utility savings, maintenance savings, replacement costs, etc.). The client provides their cost of capital, corporate tax rate and other data unique to their organization. The way depreciation is handled can provide substantial tax savings and play a large part in the calculations, as many of the design solutions that meet the objectives of a highly adaptable synchronized workplace are modular, non-fixed building elements. For example, raised floor systems and demountable partitions enhance many building systems but can also be depreciated on accelerated schedules.

As an illustration, below is a typical summary sheet that is the result of studying numerous building system alternatives for a new office, research and development facility. In this particular study, this organization had a 15% “renovation rate,” which is different than churn, as churn typically just involves “box moves.” “Renovation rate” is the frequency with which an organization demolishes and rebuilds interior spaces (removal of full height walls, HVAC, lighting, etc.).

Some of the building systems alternatives versus the base case for this example were:

- Utilize a raised floor to deliver all HVAC, voice, data and power versus a conventional approach of ducted supply and return air plenum in the ceiling.
- Utilize modular wiring versus conventional panelboards and electrical closets.
- Utilize demountable full height walls versus metal stud and drywall.
- Utilize non-electrified system furniture panels enabled by the raised floor system.
- Consider a highly reflective thermoplastic polyolefin membrane roof in lieu of a legacy standard coal tar pitch roof.
- Study different glazing systems for the shell building curtain wall.

The summary sheet below illustrates different building systems that were analyzed together in a holistic approach and in concert with an organization’s financial, churn, renovation rate, maintenance information, tax savings, etc. The results prove as illustrated that a building system design that may seem cost prohibitive when viewed in isolation could, in fact, result in a substantial gain in net present value to an organization while also providing a better facility.

The decision to install a raised floor system and demountable partitions for full height walls is an example in this illustration of how if first cost and a limited project budget drive solutions, these systems would typically be eliminated - especially if viewed independently of other systems. However, with the high performance facility synchronization approach, the raised floor and demountable partitions are analyzed as enablers for other systems and for potential tax benefits. The raised floor enables modular wire systems, allows for greater worker comfort and individual preference, and eliminates the need for the added expense of electrified systems furniture. Both the raised floor and demountable partitions have enormous benefits in the ability to renovate and adapt the space in days versus months, and without disruption or down time. Both systems can be depreciated on an accelerated schedule as well. The end result is a substantial gain in net present value to the organization and a facility design that serves the company’s objectives.

Summary Sheet – New Office/R&D Facility

		Costs / Savings Comparisons								
System	Alternative	Gain (loss) initial construction cost - $Δ	Utility savings (loss) - $Δ	Maintenance savings (loss) $Δ	Replacement cost savings (loss) $Δ	renovation savings (loss) $Δ	tax savings (loss) $Δ	Total gain (loss) from difference in NPV - $Δ	Payback in years (Note 1)	Notes
Air Quality										
	Underfloor HVAC	(100,385)	111,568	12,902	(7,387)	92,170	137,836	**$246,705**	NA	Base case: Ducted supply in ceiling return plenum
Thermal										
	Air cooled chiller & electric heat	0	0	0	0	0	0	**$0**	N/A	Base case: same as synchronized thermal control
Connectivity										
	Modular Wiring	180,753	0	0	0	216,733	51,445	**$448,932**	NA	
Lighting										
	Lighting System	43,039	0	0	0	92,750	19,134	**$154,924**	NA	
Interior Space Enclosure									NA	
	Raised Floor System	(813,835)	0	0	0	0	229,974	**($583,861)**	NA	Base case: Floor deck without raised floor.
									NA	
	Demountable Walls	(1,480,860)	0	7,142	0	793,608	690,541	**$10,431**	NA	Drywall on metal stud framing, up to bottom of ceiling
	Non-electric Systems Furniture	31,212	0	0	0	0	(9,023)	**$22,189**	NA	Base case: Electrified systems furniture panels with data and voice cabling
Exterior Skin										
	All glass curtain wall: uncoated Azure with uncoated spandrel	72,649	(2,947)	0	0	0	(6,325)	**$63,377**		Base: precast panels w/ low E glass, U = 0.33
	High-reflective thermoplastic polyolefin (TPO) membrane	58,860	0	0	(1,062)	0	(5,125)	**$52,673**		Base: ballasted coal tar built-up roof
Total		**(2,008,567)**	**108,621**	**20,044**	**(8,449)**	**1,195,262**	**1,108,457**	**$415,370**		

It is also important to consider qualitative results when utilizing a high performance facility synchronized approach to building design. Qualitative issues are perhaps the most undefined challenges facing the designers and facility managers because they affect people's performance. A high performance facility can satisfy many qualitative demands. The example of the office research and development building above achieves the following qualitative improvements versus the conventional base design:

	Conventional (base design)	Synchronized Design
Air Quality	• Code compliance for air exchange	• Improved air quality into workplace by fresh air and at filtration at the occupied zone versus at ceiling - less absenteeism, greater productivity
Thermal	• Fixed ductwork diffusers in ceiling cannot be easily relocated for personal preference or group dynamics	• Individual VAV control - personal preference by ease of access at floor can be relocated in hours
Connectivity	• Embedded technology • Centralized panel board and electrical closets	• Add, upgrade or replace technology as the need arises in hours or individual and team dynamics
Lighting	• Limited flexibility in ceiling - minimal zones	• More options for multiple objectives of individuals and teams • Greater use of natural light, task lighting, sensors, less glare, increased productivity
Interior Spaces	• Less attention to acoustics - inability to adapt the space for changes in work process and adjacencies	• Supports an organization that has a need to adapt the office for new individual and group needs and locations frequently
Building Shell	• Corporate image doesn't support work processes in the office space within	• Access to natural light for most occupants • Building shell integrated with internal systems becomes enabler that supports work process and energy efficiency

In conclusion, by utilizing High Performance Facility Synchronization, the facility can achieve both quantitative and qualitative improvement in quality and performance. Financially, for example, the performance capability, flexibility, and tax benefits of modular systems overcome the first-cost advantage of conventional construction. In addition, flexibility gains can enhance work processes by saving time and providing easier access to the infrastructure and support future expansion, reconfiguration or reduction in space. This new approach could help to improve a facility in supporting the business objectives of the organization.