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Building the School of the Future

Discovery Brief 02: Principles of IT Infrastructure Planning



“Flexibility is the most important attribute of an IT infrastructure. An infrastructure that’s successful today – but inflexible – won’t be successful tomorrow.”

Bob Westall

Executive Director, Technology Services Team
The School District of Philadelphia

“From the very beginning, we knew we wanted to deploy technologies that are largely invisible. We want technology to enable the learning experience, not intrude upon it.”

George Li

Computer Network Specialist, Technology Services Team
The School District of Philadelphia

Over the next three years, the School District of Philadelphia and Microsoft will collaborate on the ambitious task of imagining and constructing a “School of the Future.” Bringing together the best of what industry and education have to offer, our mission is to create a living blueprint for learning environments in the 21st century.

To get there, we need to capture what we learn, outline key steps, illustrate critical insights, understand challenges, and share the solutions. Discover the five guiding principles we’re utilizing to design and develop an IT infrastructure for the School of the Future.

No school is an island.

When the technology services team at the School District of Philadelphia first set out to imagine, concept, and specify the School of the Future’s IT infrastructure, they knew it would need to be “future-proof.” Engineers and educators alike recognized they were designing a school that would open in 2006 – but be ready for 2016. The team effectively needed to plan ten years into the future of networking and computing. At the same time, the team also realized that the school could not exist in a vacuum. The technologies at work in the School of the Future would have to marry with standards established for all new schools in the district if they were to realize the vision of testing and evaluating new ideas in the new school and then replicating them everywhere. Also, the technologies would need to successfully interface with legacy systems at the district level – hardware and software that is, frankly, definitively not from the future. So the team’s approach to IT infrastructure needed to balance a vision for technology and education in 2016 with how the School of the Future is interconnected with past and present district assets. The team focused on keeping maintenance, support, and daily operational costs in check wherever possible. At the same time, the team carefully inserted “next-generation” systems and infrastructure into the existing legacy environments. Several important aspects of the technical infrastructure helped the team successfully execute the balancing act between the promise of new technologies and the limitations of legacy environments, including:

- High-bandwidth Internet connectivity (2000 Mbps) over metropolitan fiber
- Gigabit-switched access to every network access point
- Standardization of high-maintenance infrastructure (PBX systems, networking equipment; end-user devices such as telephones, printing/imaging, projection systems, etc.)
- Modular and expandable WLAN infrastructure
- Existing services – voicemail, e-mail, parental telephone notification service, remote access

Key Challenge: The School of the Future features a collection of interconnected e-systems and Web-enabled services to facilitate student records, classroom management, electronic curriculum, point-of-sale systems, procurement, inventory, environmental management, security, parental portals, and more. All these new systems will require interfacing with key existing legacy systems that are characterized by archaic data access and organizational structures. The lack of an effective data warehousing repository, the use of under-powered and “closed” database platforms, problems with database connectivity (e.g., ODBC) and data cleansing, and district-wide difficulties with data entry and ownership create a complicated back-drop for the insertion of new technologies.

Key Learning: Creating an IT infrastructure plan for a new school isn’t just about plugging in the latest and greatest – it’s about balancing competing forces. Educators and technologists need to reach for the possibilities of the future, plan for the realities of the present, and account for limitations created by the past – all at the same time.

Function drives form.

One of the original precepts of the School of the Future is that we're building a space focused on teaching and learning, not technology. Yes, technology is an integral part of our mission to create a living blueprint for learning environments in the 21st century. And technology, particularly in the last decade, has become as famous for its form as its function. So given the opportunity to build a school from the ground up, it would have been understandable if the technology services team dreamed up a school shimmering with plasma screens and glittering with LEDs. Instead, the team emphasized using technology to fuel a continuous, relevant, and adaptive learning environment and believed that enabling technologies in their purest form should be nearly invisible. That belief guided decision making on everything from Internet access to security and will ultimately result in several defining features. For instance, wireless technologies will offer flexible access to the Internet and intranet throughout the building and extended campus – moving instruction beyond the end of a cable. Also, safety and security functionality will be embedded in architectural elements – removing the ominous presence of metal detectors while delivering the same benefit.

Key Challenge: From a technology standpoint, the School of the Future offers an enormous opportunity – and temptation. From the first brainstorm meeting, the team understood that one of the central challenges of imagining and implementing next-generation technology is being faithful to the idea of technology as an enabler of teaching and learning and resisting the allure of the shiny and the new.

Key Learning: The best IT infrastructure is deliberately designed to advance teaching and learning. Educators and technologists should see technology through the lens of how it solves real problems and furthers the educational experience.

Architectural decisions matter.

The design and deployment of IT infrastructure needs to occur collaboratively alongside the design and construction of the building itself. To that end, the technology services team worked closely with the architects commissioned to build the School of the Future, exchanging ideas and understanding the implications of each group's design solutions. However, architectural sketches and drawings don't reveal the intricacies of the building until the school is actually constructed. So though technical infrastructure and building architecture are ideally planned collaboratively and concurrently, the IT team is tasked with the significant challenge of imagining a fully finished building while it is still in the planning stages. Knowing as much as possible about how wireless technologies are going to perform in a planned space, for instance, reinforces the absolute importance of understanding and taking into account architectural decisions.

Key Challenge: The significance of shape, size, and location in building architecture is no secret to network engineers. However, other people involved in the design process may not share that awareness. The team needed to collaborate closely with everyone involved in building design to communicate the impact of architectural decisions. Specifically, the team needed to create awareness around three issues:

- Wireless networking is sensitive to the composition of wall and ceiling materials, given that materials affect the absorption and reflection of signals differently. Metallic ceiling grids, metal studs, concrete, and glass surfaces will all have varying effects on signals and require careful consideration in the design of a high-density wireless space.
- Wireless environments in newly designed facilities require far more design diligence and attention to building architecture than those in a retrofitted facility. New facility design becomes more art than science since the potential signal patterns and fields are entirely theoretical (versus a retrofit where an actual analysis can be easily conducted in each existing learning space).
- Wall and ceiling clearances dictate the potential spectrum of recessed fixtures such as audio-visual centers, telephone enclosures, security/locking mechanisms, and others.

Key Learning: IT infrastructure and building architecture are both design processes. Technologists and architects need to work collaboratively and concurrently to inform each other's decision making, integrate technical performance with physical space, and bring to life the power of design across both disciplines.

Flexibility is critical.

Technologies – and the application of technologies – must account for external factors such as legacy systems at the district level and internal factors such as the ramifications of architectural decisions. For these reasons, flexibility is imperative when developing an effective IT infrastructure. The School of the Future technology team understood that the only way to realistically design a future-proof IT infrastructure was to put a premium on flexibility. Hardware systems and software applications will always evolve and change. Best practices for implementing technologies will continually advance alongside changes in instructional strategies. Building in the ability to go where technology will go is the only way to effectively create a physical space that isn't behind the times the day it's completed. And building flexibility into an IT infrastructure starts from the very beginning, not after it's become outdated.

Key Challenge: Imagining new technologies and how those technologies will be used in the future is a challenge shaped more by the unknown than the known, making a focus on flexibility essential.

Key Learning: Technologies evolve with the forces that shape their implementation within the teaching and learning experience. School facilities will always be faced with changing and evolving instructional models. Building a successful infrastructure for tomorrow means building a flexible infrastructure today. To build an infrastructure that is as “future proofed” as possible, keep in mind:

- An adequate and uniform density of copper, fiber, and electricity throughout all learning and administrative rooms will permit future repurposing without resorting to major construction.
- Industry standards are the way to go. Proprietary solutions only limit flexibility. They may not be supported by other vendors, which further limits choice.
- Strong partnerships with technology companies allow you to see new technology in development and give you the opportunity to provide feedback about attributes and features that are important in your environment.
- Hardwire infrastructure should always be included in all network infrastructures. Any device – from a server to an access point (AP) to a wireless device – must sit upon a wired network.

Cost is always a factor.

The first meeting of the technology services team was a two-hour brainstorm culminating in a wish list of 100 items for the School of the Future. During the next meeting, the team anticipated cost concerns and set out to trim any non-essential items from the wish list. The result? One item – an Internet-enabled television for the teacher's lounge – was scratched from the list, effectively designating the other 99 as essential. Over the next few months, as the realities of budget constraints emerged more clearly, the team weighed the complexities of up-front costs and long-term operational costs – an exercise that forced them to focus on elements of the IT infrastructure that were irreplaceable to their vision. In the beginning, there was a blurry line between what the team wanted and what the team needed. In the end, the budget helped them focus more clearly on the components of the infrastructure that are essential to the mission of the school.

Key Challenge: Budget constraints are always a challenge. And as with any other school, the technology team found themselves competing with advocates for other interests – from athletic facilities to landscape architecture to kitchen and dining areas. Given the inevitable budget constraints, the central challenge was not protecting their interests as technologists but understanding and communicating how each attribute of their technology plan aligned with the core functionalities of the school (instructional, operational, and environmental). The team defined three areas where attributes could be removed with the least impact on the overall environment.

- “Reserved” infrastructure – excess networking drops, empty conduits, and other pieces of infrastructure that would not be put to immediate use.
- Complex systems that would require very large investments to interface or incorporate into existing legacy infrastructures and processes.
- Reduced scope applications – “wish list” casualties such as classroom surveillance cameras, flat panel marquees, high-end voice/video communications, and other nice-but-not-necessary amenities.

Key Learning: What's most important is always more clearly recognizable than what's least important. Technologists and educators should expect budget constraints to force cost tradeoffs and embrace them as a way of aligning around the most critical components.

Partners in Learning

Technology is a powerful tool that can help people, communities, and nations realize their potential. But for millions, the promise of technology is still unrealized. Microsoft Corporation has made a comprehensive commitment to digital inclusion – helping individuals, communities, and nations gain access to the technology tools, skills, and innovation they need to realize their potential in the changing economy. Microsoft's flagship digital inclusion initiative is Partners in Learning.

Despite real improvements in accessing and using information and communication technology in education, many students and teachers still lack basic access to technology and training. The result is a widening skills gap that contributes to disparities in quality of life, competitiveness, and economic development.

Part of the Microsoft® Partners in Learning initiative, the School of the Future is an important example of our commitment to addressing the digital inclusion issues facing education today by providing tools and support that enable educators and schools to deliver on the promise of technology in education.

For more information on Microsoft Partners in Learning, go to: www.microsoft.com/education/partnersinlearning

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