

# **Hospital Operating System** ***Unleashing Throughput Potential***

White Paper

***Case Study: Mercy St Vincent Medical Center***

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# Introduction: Throughput Challenge

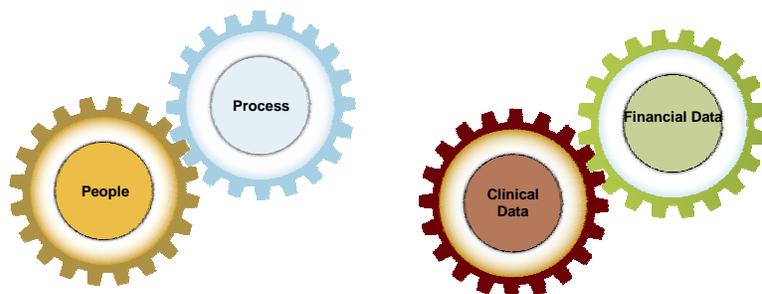
In the business management theory of constraints, throughput is the rate at which a system achieves its purpose. For a hospital the purpose or “aim of the system”, as W. Edward Deming refers to it, is to deliver quality patient care as efficiently as possible. Unfortunately, the fragmentation of a hospital’s activities across departmental operational silos propagates waste, compromising throughput.

The assertion of this white paper is that a hospital will not be able to manage throughput for the achievement of its purpose until it becomes a system of *interconnected* activities.

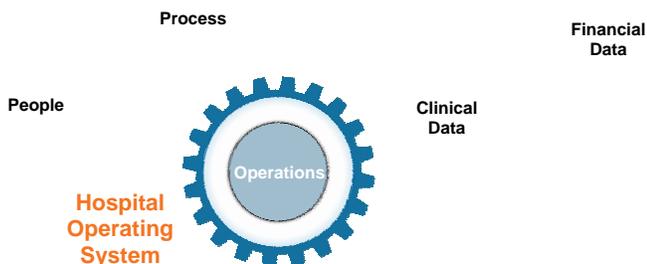
Most hospitals function as a collection of departments or independent operating units. W. Edward Deming widely credited with improving production in the United States during the cold war through the application of his statistical process control theories, describes such organizations as lacking “system aim”, resulting in impaired throughput and competition for limited resources among silo-based components struggling to optimize their part of the operation. Evidence of this competition is prevalent in hospitals demonstrated by competition for beds, wheelchairs, medications, IV pumps, and so forth. While significant process improvement efforts have been undertaken to attempt to resolve the symptoms of this fragmented delivery process, these efforts have largely failed because they are not addressing the root cause. Disconnected patient care activities are the root cause of what is “wrong with healthcare”: highly variable service delivery, inconsistent quality and performance outcomes, and reduced patient, provider, staff, and employer satisfaction.

**“Health care is characterized by fragmentation — among disciplines, among departments, among organizations, and among geographic locales — while those it serves depend on coordinated effort. The system propagates waste: waste of time, resources, and good will”**  
(To Err is Human – The Institute of Medicine)

*An operational gear is missing...*



What is missing is a hospital operating system which connects all of a hospital's disparate activities into one interconnected system, providing real-time operational data so leaders can “manage what is measured”. A hospital operating system would allow hospitals to expose the non-value added white space (wait times, delays, and other wasted actions) in operations, and to facilitate patient throughput actions across departments in support of system aim.



The good news is that this has been done before. The healthcare industry can learn from how other industries have addressed similar throughput challenges. From the airline industry (air traffic control), to automotive (Toyota Production System - TPS), to retail (Walmart), to package express (UPS and FedEx) many industries have already addressed the fragmentation of activities across operational silos, identifying and eliminating waste, and effectively improving throughput performance. The outcomes have been the fulfillment of organizational purpose and significant competitive advantage.

This white paper details an operational case study of Mercy St Vincent Medical Center in Ohio. It embarked on a throughput transformation effort which connected disparate patient care activities into a hospital operating system in support of the system aim of quality patient throughput. The label that Mercy St Vincent applies to its transformation effort is “Patient First: Journey to Zero” (zero errors and zero re-work). As disparate activities became interconnected and waste was eliminated, Mercy St Vincent experienced rapid improvements in length of stay (LOS), cost savings, and improved admission volumes in spite of a down economic market. These results have been validated by the Health Systems Institute at Georgia Tech, the leading graduate program in health systems engineering.

## Case Study

Mercy St. Vincent Medical Center, a 400+ bed teaching hospital in Northern Ohio, is the critical care regional referral and teaching center within the Mercy Health Partners (MHP) system, a seven-hospital faith-based system serving Northwest Ohio and Southern Michigan. MHP is a member of Catholic Healthcare Partners (CHP), which consists of 36 hospitals, long-term care facilities, hospice programs and home health agencies across five states.

Mercy St Vincent's President/CEO is Imran Andrabi, MD. Dr Andrabi is a family practice physician who had previously served as the Chief Academic Officer and Chief Operations Office.

### Operational Status & Challenges

By all external standards, Mercy St Vincent Medical Center has been a high performing hospital: winning a top 100 hospital designation, earning a JD Powers & Associates top performer award, and rating equally well on other standards of performance from patient satisfaction scores to regulatory compliance and core measure outcomes. Like many other high achievement hospitals, they had already initiated a Lean and Six Sigma department in 2006, a DRG assurance program, employee retention and training programs, a top-ranked patient satisfaction improvement program, and a CPOE/EMR system.

Patient throughput problems persisted at Mercy St Vincent however which negatively impacted organizational performance measures. The downturn in the economy hit the northern Ohio market particularly hard, causing the unemployment rate to climb to 15%, and exacerbating the challenges Mercy St Vincent already faced. As expected, non-pay cases increased and elective procedures dropped.

Mercy St Vincent engaged strategic partners to assist in their transformation effort. An operational discovery audit was conducted in order to better understand the reasons behind the challenges that Mercy St Vincent faced and to provide a starting point for current to future state design. Summary findings included:

***“We had layered one improvement program on top of the next in an attempt to secure breakthrough performance but never achieved sustainable improvement”.***

*(Samantha Platzke, Senior Vice President, CFO, and Chief Transformation Officer -*

***“We were experiencing significant operational challenges due to market turbulence, process inefficiencies, and stretched facility and personnel resources. We knew we needed to approach this problem differently than we had in the past in order to succeed for the long term.***

*(Imran Andrabi, MD, President/CEO Mercy St Vincent)*

1. Enterprise patient flow had no system aim and no senior role who “owned it”
2. There were no clear system level throughput or capacity key performance indicators
3. Department level performance improvement efforts were underway, however those efforts did not roll up to a system level initiative
4. Competition existed between departments for limited resources. Examples:
  - a. Critical care beds – OR and ED were competing for the same beds
  - b. Excessive use of ‘stat’ when ordering services, tests, and pharmaceuticals (30% on average)
5. Responses to flow challenges were reactionary

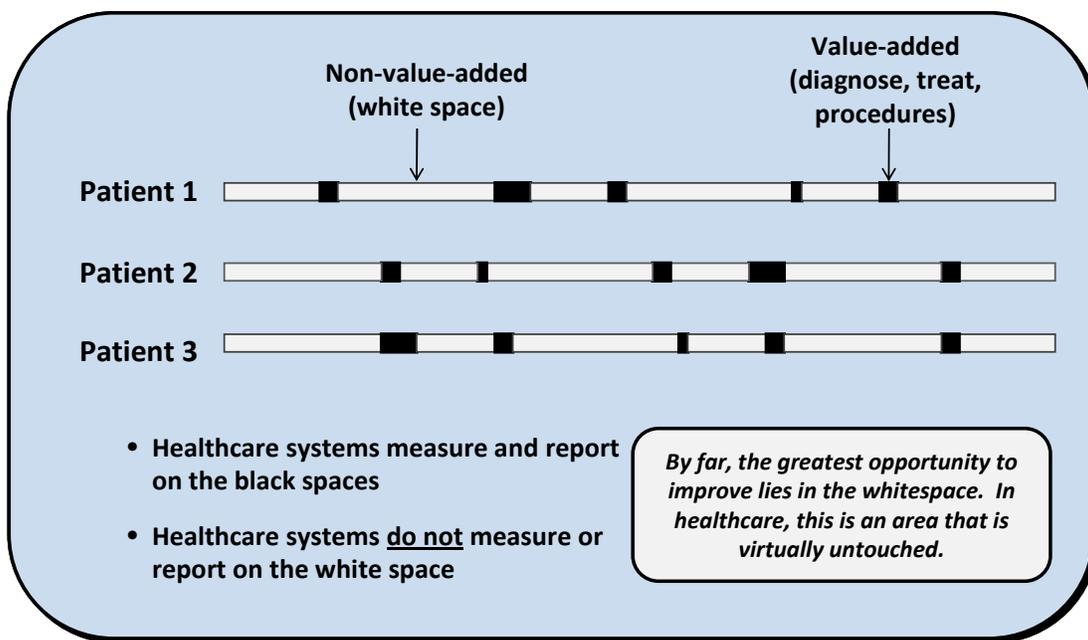
As the operational discovery audit demonstrated, Mercy St Vincent was not functioning as an integrated system. Rather, it was an assemblage of disconnected islands of excellence. That learning helped to explain why previous improvement efforts, which had focused on problem areas within the silos, had not yet resulted in improved throughput.

### White Space

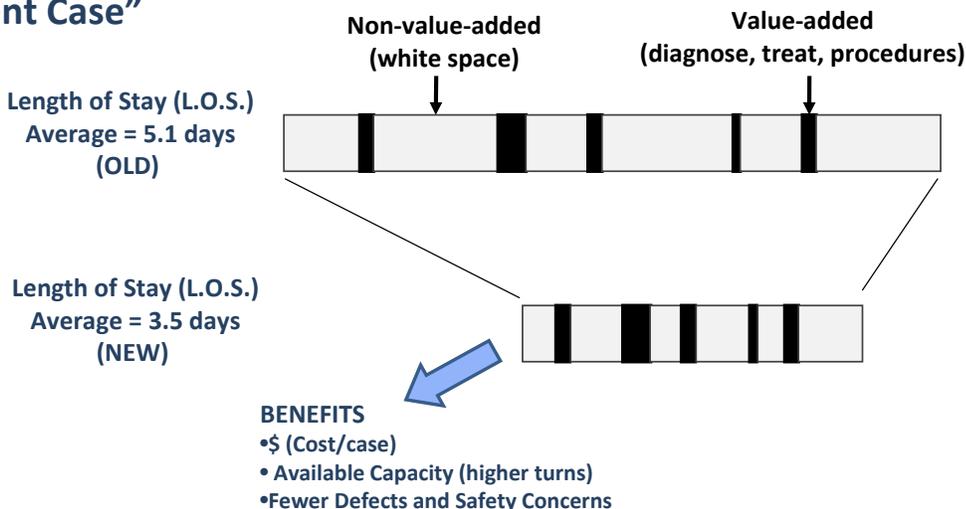
Non-value added actions or white space were abundant with Mercy St Vincent operations as they are in most hospitals. For example, the phone calls and time required for nurses to coordinate the diagnostic, procedural, and services delivery for their patients is not direct value-added action. Another example was the cross-departmental coordination and phone calls necessary to facilitate a unit transfer. If this white space could be identified and eliminated, and these disparate activities could be interconnected it would translate into improved patient throughput.

*We came to understand that a lot of non-value added activities were inherent in our patient throughput processes, something we came to call "white space." We had no clear system aim and no enterprise-wide operational flow system to give us the data necessary to see or respond effectively to the white space. We were in a non-productive cycle of anecdote and opinion driving inaccurate conclusions and unintended consequences" (Imran Andrabi, MD, President/CEO Mercy St Vincent)*

The diagrams below demonstrate the concept of white space, the process of identifying it, and the effect of reducing or eliminating it.



### "The Average Patient Case"



## Current State Analysis

Senior leaders at Mercy St Vincent took the initial discovery findings seriously and collaborated on a detailed current state process flow analysis to better understand how disparate activities and white space were resulting in persistent patient throughput challenges. Key flow challenges were analyzed in preparation for future state design in support of Mercy St Vincent's system aim. All processes were evaluated as interconnected activities within the dynamic environment of hospital operations.

**“A system is a network of interdependent components that work together to try to accomplish the aim of the system. A system must have an aim. Without the aim, there is no system.”**  
(W. Edward Deming)

This first phase of the transformation effort was difficult work. It required St Vincent Mercy senior leaders to develop a deep understanding of their front line operations and to be persistent enough to achieve the insights necessary to drive an effective future state design.

**“It was not until we appreciated the impact of our disconnected processes and the associated non-value added ‘white space’ waste, that we were then able to identify the levers necessary to realign our organization around a system aim of quality patient throughput.”** (Imran Andrabi, MD, President/CEO Mercy St Vincent)

## System Aim & Future State

Once the root cause challenges were understood and prioritized, the Mercy St Vincent senior team was able to clarify their system aim as “quality patient throughput”. The label that they gave their system aim effort was “Patient First: Journey to Zero”. With help from their strategic partners, Mercy St Vincent developed future state process flows and the operational levers necessary to make their transformational efforts a reality. The clarity of their system aim enabled them to

see their operation through a different lens. This new perspective helped drive them to make some important changes that they would not have otherwise initiated. For example:

1. Launching a centralized care coordination center hub to manage hospital-wide operations
2. Moving case management into the forefront of operations and patient flow logistics
3. Designating clinical care coordinators in each operational unit to be closely aligned with the hub

In order to effectuate and sustain Mercy St Vincent's improvements future state processes were hardwired into the hospital operating system technology so that the daily chaos of hospital operations could be effectively coordinated. Key performance indicators were reported on from the hospital operating system reporting database so that Mercy St Vincent could receive real-time feedback on their progress, and alerts when adjustments were necessary.

## Results

Barb Martin, Chief Nursing Officer at Mercy St Vincent explains Mercy St Vincent's results as follows.

*“Reduction in employee expenses per day as a measure of efficiency accounted for 34% of our cost savings. We were able to eliminate agency costs and nursing premium pay. We no longer needed the Observation Unit as status is now taken care of upfront – that was 16 dedicated FTE’s. In spite of significant process change our employee opinion scores went up, and our nurse separation rate also improved by 41%. LOS improvements as a measure of throughput accounted for the other 66% of the cost savings. We experienced a 0.7 day reduction in non-CMI adjusted LOS from 5.1 to 4.4. As a result our cost per EIPA-CMI adjusted (equivalent inpatient admission - adjusted for outpatients and case mix) improved significantly. One of the more interesting outcomes is that the LOS improvements saved us 10,400 days annually which gave us the ability to care for 2,260 more admissions with no additional capital or fixed costs. That new volume represents the size of one of our sister hospitals, Mercy Tiffen. So in effect, we created another hospital within a hospital from a capacity standpoint.”*

**One year after initiating this transformational effort, St Vincent Mercy reduced their ALOS by 14.3%, lowered their direct costs by \$8.6 million, and increased their admission volume by 11.2% for a total impact of \$10.3 million.** (Confirmed by the Health Systems Institute at Georgia Tech)

**The 11.2% increase in Mercy St Vincent's admission volume, in spite of a down economic market, was a direct result of improved throughput. Physician affinity is closely tied to efficient patient throughput processes.**

Physicians are often frustrated when rounding because they do not know where the patient is or the status of the orders. Physicians admit patients and round at all hours and are typically time-pressed to get to the next patient or move on to the operating room. Improved throughput benefits hospitals and physicians alike.

Mercy St Vincent considered physician throughput needs carefully during the future state design process. For example, the decision to create a central logistics hub and departmental clinical care coordinators so that patient movement and status notifications could be expedited was very important to the physicians. The result has been positive cycle of improvement leading to better physician affinity driving increased admissions.

## Transformational Approach

### Three Ingredients

There were three interactive improvement ingredients that were essential for Mercy St Vincent to connect disparate processes, wash out white space, and improve throughput.

1. Mindset – System Aim Alignment
2. Methodology – Transformation Engineering
3. Technology – Adaptive System Intelligence

### Mindset – System Aim Alignment

In the airline industry the FAA has mandated that “safety first” be the aim of the system. Everything from detailed aircraft maintenance audits and service, mandatory safety instructions, and passenger and safety checks before takeoff by the flight attendants are actions aligned around the system aim of safety first. As a result, the likelihood of injury or death is greatly reduced.

When Mercy St Vincent clarified that “quality patient throughput” was their system aim, it became the lens through which they evaluated every current process, role, and function. The realignment of their operation to that system aim gave them the framework by which to make trade-off decisions as they selected their future state. Examples as mentioned previously included:

***“It is important not to define the aim of a system in terms of activity or methods. It must always relate directly to how life is better for everyone. The aim of the system must be clear to everyone in the system. The aim must include plans for the future. The aim is a value judgment.” (Edward Deming)***

1. Launching a care coordination center as a hub for hospital-wide operations
2. Moving case management more into the forefront of operations, and
3. Designating clinical care coordinators in each operational unit who were closely aligned with the hub

If Mercy St Vincent’s system aim for example had been to “reduce resource consumption per patient” then the expression of that system aim would have likely resulted in reduced variable cost per patient, but it would not have necessarily resulted in improved throughput or the quality of care for patients.

As the awards and recognition achieved by Mercy St Vincent prior to beginning their operational transformation demonstrates, many hospitals achieve recognition for relative comparative performance, and yet still have not reached their full operational potential. The measuring stick itself may be incorrect. As long as all hospitals are constrained by the fragmentation of silo-based operations, comparative benchmarking will be flawed. When exceptional throughput begins to appear within an industry sector performance standards begin to change. A good example of this was the transition to ISO-9000 standards in manufacturing. How then does the fragmentation of silo-based operations play itself out in today’s hospital?

***While a simple concept, the power of system aim in operational transformation should not be underestimated. Particularly given the prevalence of silo-based operations and thinking that characterizes today’s healthcare industry.***

The typical hospital is comprised of many “islands of excellence.”

Individual departments work to meet or exceed patient care standards for their particular discipline. While this is admirable on the surface, the unintended consequence is a department-centric paradigm which encourages improved component performance at the expense of system throughput. In silo-based operations, the lack of

system aim leads to disconnected islands of excellence. This adversely impacts throughput in three key ways:

***“Management of a system requires the constant facilitation of the interrelationships between all of the components within the system and of the people working in it.” (W.Edward Deming)***

1. **Cross-vertical handoffs do not occur seamlessly.** Ideally, the movement of patients from admission through diagnostics, treatment, nursing units, and finally to discharge occurs without significant delays. In department-centric hospitals one department’s needs

are not necessarily compatible with another department's priorities. For instance, nurses on a med/surg unit may not notify bed management — or they may do so only after a substantial delay — that a bed has been vacated. Consequently, there are vacant beds that could be occupied by revenue-generating patients — who are kept waiting somewhere else.

2. **Inputs and outputs are controlled at a departmental, not system, level.** Unless the hospital is on diversion, the usual patient entry points (i.e., the admission office and the emergency department) have little or no control over their admitting patient volumes. In other words, they are expected to accommodate all comers. Problems arise when other departments, such as nursing units, limit their inputs, causing a backlog of patients and making it difficult to deliver patient care according to prescribed protocols. As described earlier, these obstacles are not intentional. Rather, they reflect the exercise of departmental priorities over system aim.
3. **Efficiencies gained in one department do not necessary contribute to hospital-wide patient flow.** As Mercy St Vincent's experience demonstrates, it is quite common in hospitals to undertake departmental efficiency improvement initiatives. Frequently, when departmental flow is optimized with respect to system flow, poor system throughput performance is the result (it is sub-optimized). For example, if the emergency department boosts its efficiency, but it is not coordinated with a similar endeavor on the nursing units, particularly the critical care units, the number of ED boarder patients will rise. This optimization of departmental flow at the expense of system throughput is a frequent occurrence in the healthcare industry.

The symptoms of silo-based operations are:

- Anecdote and opinion about system throughput challenges replaces fact-based understanding and decision making
- Low coordination and collaboration persist instead of orchestrated care execution around system aim objectives
- Non-value added white space is not visible or well understood, particularly in the hand-offs between operational units
- Hospital flow tasks stay open-looped, meaning they are not completed on time and correctly from a system flow standpoint
- Unintended consequences are experienced as operational components compete for limited resources

## Methodology – Transformation Engineering

In spite of a well defined Lean and Six Sigma department, Mercy St Vincent had not achieved the improved throughput performance they desired. As discussed, there was an absence of a clear system aim and the enterprise operational levers necessary to facilitate improved throughput. However, the fragmentation of processes and daily chaos of healthcare operations also had to be taken into account when evaluating Mercy St Vincent's system throughput opportunities.

**When hospitals like Mercy St Vincent break out of the operational constraints of silo-based thinking a paradigm shift occurs, unleashing their potential for significant performance breakthroughs.**

**While automotive, shipping and other similar industries have dramatically lowered costs, improved quality, and decreased variability across their entire enterprise, hospitals have not enjoyed the same sustainable success using identical process improvement (PI) tools**

In some industries, work is performed in environments that are more predictable, so performance improvement principles can be applied to create reproducible processes that will work for longer periods of time. While a factory for example, may succeed in keeping its environment relatively static, hospitals cannot. Daily variability in patient needs, volumes, and provider and resource availability result in an environment that is fundamentally dynamic.

Deming instructs that “*If you can't describe what you are doing as a process, you don't know what you're doing.*” The dynamic interconnectedness of hospital operating processes has to be well understood before crafting future state recommendations.

For Mercy St Vincent, this important principle was used when developing the current state to future state design. Process flows from admission through discharge were simultaneously evaluated through the system aim lens of “quality patient throughput” and the dynamic nature of the interconnected flow processes. Major milestones or key performance indicators (KPI's) for all critical future state processes were identified and linked to the respective sub-processes so that Mercy St Vincent could stay on top of the dynamic nature of their hospital environment and “*work on their business while they were working their business.*” Finally, all future state flows were translated into realistic standard operating procedures in support of a comprehensive training program for front-line staff in preparation the launch of Mercy St Vincent’s hospital operating system.

**Hospitals have and continue to use PI initiatives to craft improvements at a moment in time. However, these improved processes are imbedded into an inherently dynamic environment so inevitably the efficacy of the improvement degrades over time.**

## Technology – Adaptive System Intelligence

**In dynamic systems all processes are interconnected. As such, a well-tuned adaptive system should be capable of responding to the variable nature of the dynamic environment.**

To successfully leverage and sustain future state improvements within a hospital operating system, the technology must incorporate dynamic interconnectivity so that the future or ideal state can be maintained while managing the daily chaos of hospital operations.

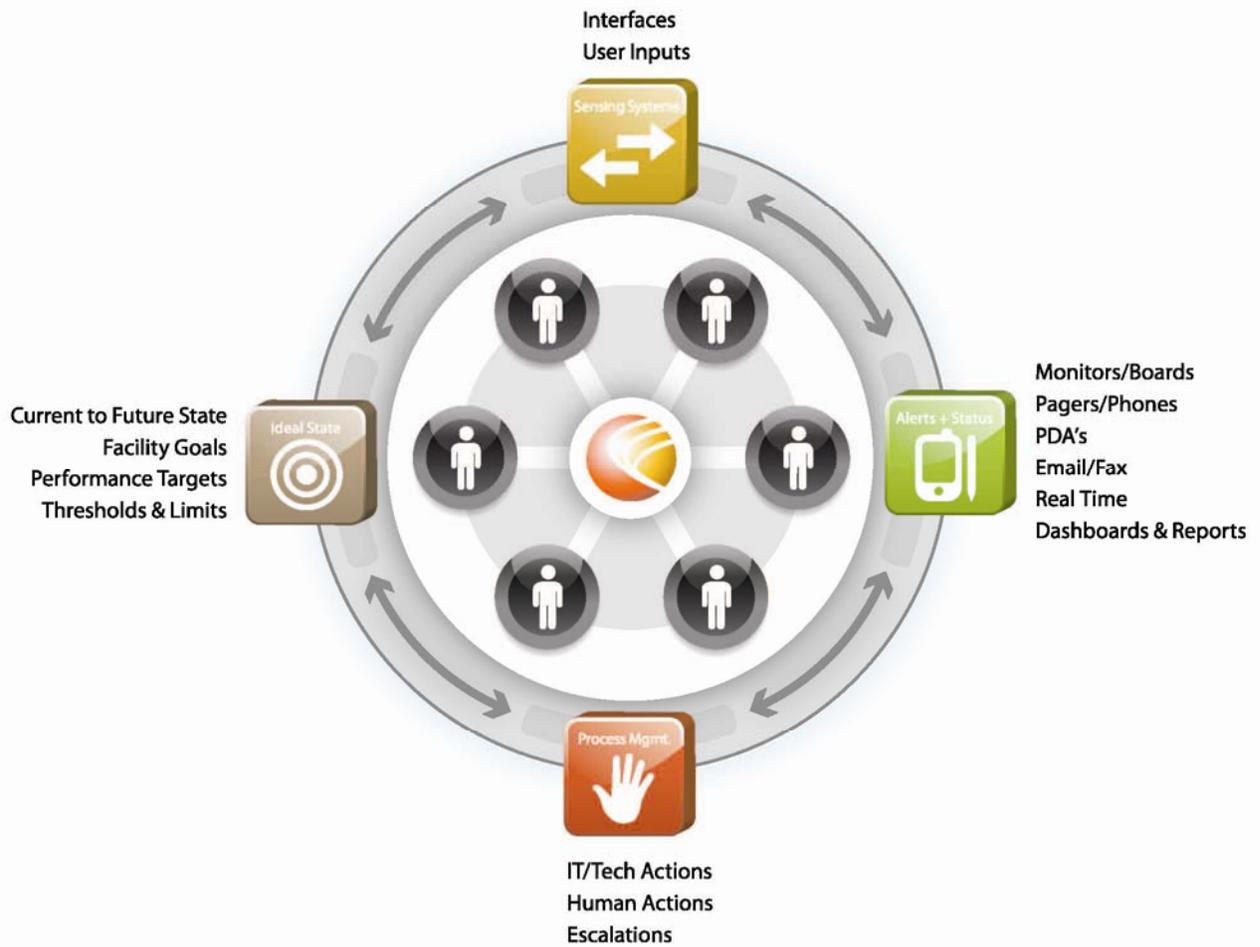
As such, a system with adaptive intelligence should have the following characteristics:

- Allow *goals* to be set
- Contain *sensing mechanisms*, registering information relevant to the system’s goals
- Contains *effector mechanisms*, allowing the system to act on its environment
- Contain *conversion processes* which take information about the environment (via the sensors), compares that information to the system’s goals and modifies the environment as necessary

As the diagram on the next page demonstrates a system with adaptive intelligence should:

- 1) Be a human-machine system comprised of people, IT systems, standard operating procedures and executive mind-set—focusing on hospital operational efficiency and quality with *enterprise impact*
- 2) Interconnect all processes that result in patient movement and order-execution including:
  - a. Visualizing pertinent information to all stakeholders
  - b. Facilitating departmental and functional hand-offs
  - c. Choreographing activities of clinical and non-clinical staff around patient flow, logistics and order execution
- 3) Be *adaptively intelligent*, meaning:
  - a. Allow for operationally relevant goals to be recorded
  - b. Receive input, in real-time, from the environment that is relevant to the system’s goals
  - c. Influence activity in the hospital in ways relevant to achieving operational goals
  - d. Compare the environment to the system’s goals and influence behaviors by sending error-correcting signals to those who can change the environment
  - e. Predict and/or recognize trends and intervene proactively

## Adaptive System Intelligence Diagram



**A system with the adaptive system intelligence defines a new breed of hospital efficiency systems – a hospital operating system**

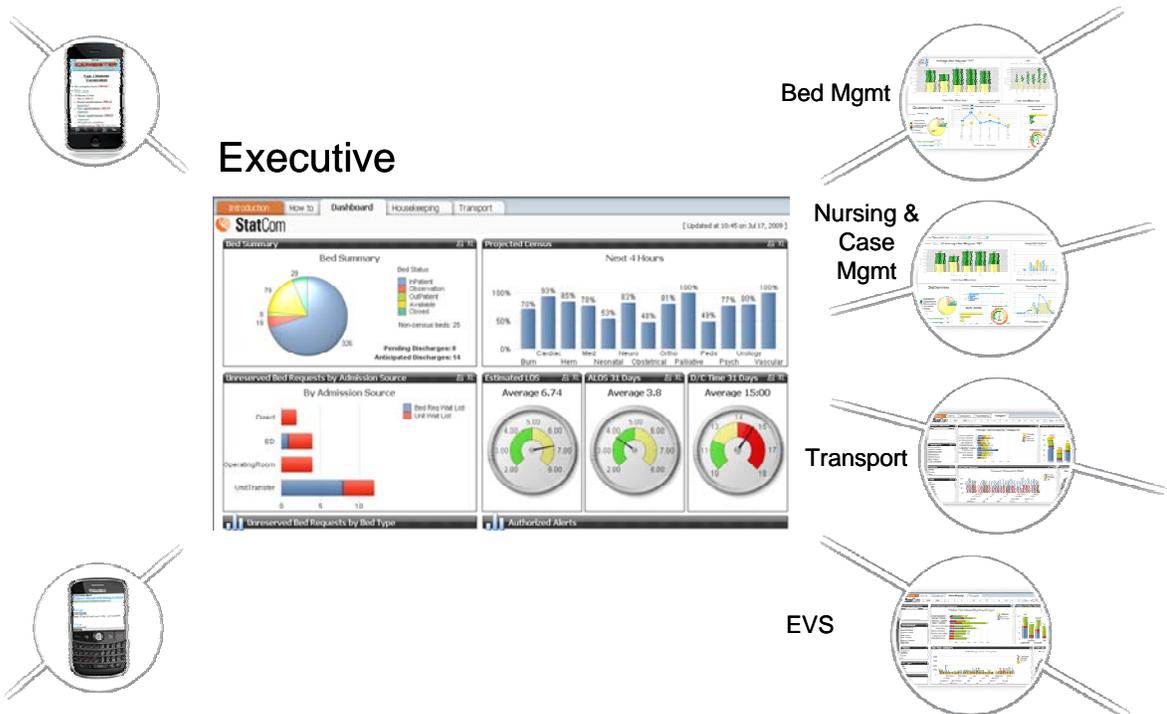
# Operational Analytics

## Performance Monitoring

To sustain and improve upon performance gains operational data and analytics must be readily available to hospital leaders. Three sources of information exist within a hospital operating system:

1. Open data base compliant (ODBC) access to raw data for manipulation within tools such as Excel, and Crystal Reports
2. Standardized reports, and
3. Real-time operational dashboards

Operational dashboards can be made available to all areas requiring real-time information in support of throughput. As demonstrated below, these operational analytics are also supported on a mobile platform for instant retrieval regardless of location.



## Learnings

### Simultaneous Patient Flow

While the healthcare industry has spent a lot of time developing individual patient care paths, the notion of optimizing *simultaneous* patient throughput with respect to LOS, quality, safety, and resource consumption gets less attention and is inherently more challenging from an operations standpoint.

As discussed previously, it is very difficult to effectively coordinate the different priorities and requirements necessary for simultaneous patient flow using manual approaches. The challenge is to manage today's chaos, not just schedule for tomorrow's anticipated load.

Similar to airport operations, reservations do not translate into smooth logistics on any given day because of constantly changing conditions. Airports manage this chaos with air traffic control and operational control centers whose algorithms make decisions upon these changing conditions.

Most hospitals do not have control systems like airports to manage daily chaos. Instead, many diagnostic and service area departments optimize their department schedule around outpatient demands and simply work inpatients in when feasible. They do this with short notice notifications to Nursing and often without visibility to the patient's pending discharge status or other priority criteria.

As a result compensatory behaviors abound including:

1. Overdependence on 'stat' designations when orders are placed
2. Work-ups being done in the ED, and using up valuable treatment space, in order to leverage the ED's priority access to diagnostics
3. Demand for critical care or step down beds increases, because of priority access to diagnostics and/or better nurse to patient ratios

### Key Transformation Priorities

- 1) Commit to system aim and who owns it
- 2) Define transformation for your organization and communicate it (e.g. "Quality Patient Throughput")
- 3) Identify patient throughput critical path (future state) vs. current processes
- 4) Surface your KPI's (major milestones) so you can "work on your business while you're working your business"
- 5) Reduce white space (i.e. Non-value added tasks and sub optimized processes)

### Ideal 'Blend' of Improvement Ingredients

To achieve optimal throughput (evaluated against LOS improvements), and based upon Mercy St Vincent's success, the Health Systems Institute at Georgia Tech suggests the following blend of technology, methodology, and mindset change ingredients.

(Note: ALOS of 3.5 represents Mercy St Vincent's target goal)

<u>How</u>	<u>LOS</u>	<u>% Change</u>	<u>% of Total</u>
<u>Impact</u>			
■ Technology	0.9	17%	55%
■ Methodology	0.4	8%	26%
■ Mindset	<u>0.3</u>	<u>6%</u>	<u>19%</u>
Total Improvement (ALOS 5.1 to 3.5)	1.6	31%	100%

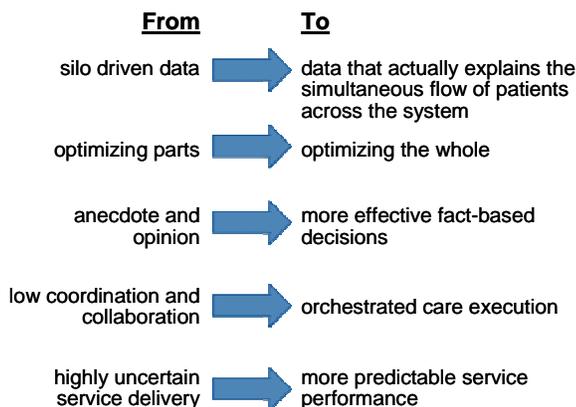
## Summary

This white paper provides a case study of how Mercy St Vincent Medical Center, a 400+ bed academic teaching hospital in Northern Ohio, was able to unleash its throughput potential in one year by linking disparate patient care activities into one interconnected hospital operating system. The essential ingredients in Mercy St Vincent's transformation were:

1. Mindset – System Aim Alignment
2. Methodology – Transformation Engineering
3. Technology – Adaptive System Intelligence

The throughput challenges that Mercy St Vincent faced are applicable to most hospitals. In spite of achieving many comparative benchmark awards, and initiating many industry standard improvements, Mercy St Vincent had not achieved the desired performance breakthrough. They needed a new approach which could leverage what they had and recalibrate their operations based upon a new paradigm.

### *A paradigm shift in operations...*



### **Mercy St Vincent Results**

In spite of a depressed economic market, including an unemployment rate of 15%, in one year Mercy St Vincent was able to:

1. Reduce their ALOS by 14.3%
2. Lower the direct costs by \$8.6 million
3. Increase their admission volume by 11.2%
4. Improve quality and safety performance measures
5. Achieve total financial impact in one year of \$10.3 million

***“It was not until we appreciated the impact of our disconnected processes and the associated non-value added ‘white space’ waste, that we were then able to identify the levers necessary to re-align our organization around a system aim of quality patient throughput.***

*(Imran Andrabi, MD, President/CEO Mercy St Vincent)*

Like most hospitals, the operational challenges that Mercy St Vincent faced included:

1. Enterprise patient flow had no system aim and no senior role who owned it
2. There were no clear system level throughput or capacity key performance indicators
3. Department level performance improvement efforts were underway; however, those efforts did not role up to a system level initiative
4. Competition existed between departments for limited resources
5. Responses to flow challenges were reactionary

The Mercy St Vincent case study demonstrates that a hospital will not be able to manage throughput for the achievement of its purpose until it becomes a system of *interconnected* activities. Mercy St Vincent's transformed throughput operations by *connecting* disparate patient care activities into a unified hospital operating system. The results are more predictable service delivery, consistent quality and performance outcomes, and improved patient, provider, and staff satisfaction.

The Mercy St Vincent's example should serve as a roadmap for other hospitals and health systems to follow.