Integrating QFD with Value Stream Mapping & Transactional Six Sigma for Lean Transformation of Healthcare System

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Presentation Outline

1. Business Case: A3 Thinking
   - Business Problem Statement
   - Business Environment Analysis
   - Value Development
   - Current Operational State
   - Perceived Leverage Opportunities
   - Relating Leverage Opportunities to Applicable Lean Tools

2. Data Collection
   - Gemba Genjitsu (Direct Behavioral Observations)
   - Numerical Data Collection (Money, Time, Numbers, Movement, Repetitions, Ambient Conditions, Productivity, Rework, Rejects etc.)

3. Data Analysis
   - Appropriate Data Organization
   - Model Development
   - Model Application
   - Model Validation

4. Improvement Strategies
   - Customer Value Enhancement
   - Productivity Improvement
   - Skill Development
   - Cycle Time Reduction
   - Waste Elimination

5. Target Condition
6. Lessons Learned
7. References
8. Questions / Comments!
1. Business Case: A3 Thinking

**Problem Statement:** Client healthcare businesses were facing a 5% ~ 7.5% reduction in revenue due to a loss of medical coverage, 10.0% ~ 11.5% (51 MM reduction in medical insurance claim reimbursement). Rising services costs due complex service procedures, rising cost of outsourced diagnostic services, internal waste, lack of standard work and under utilization of capital medical equipment.

**Continuous Improvement**

**Quality Metrics:**
1. Diagnostic PPM < 10 (Requiring Retesting)
2. Reproducibility of Vital Signs ± +/- 0.1%
3. Pathological Sample Collection ≥ 99.5%
4. Prescription Accuracy ≥ 99%
5. Equipment Reliability = 100%
6. Equipment Calibration = 100%

**Cost Metrics:**
1. Reduction in Total Out of Pocket Cost
2. Reduction in Medical Consulting Costs
3. Reduction in Diagnostic Services Costs
4. Reduction in Prescription Drug Costs
5. Reduction in Residential Services Costs
6. **All Cost Elements to Realize Improvements in the Range of 5% ~ 15% with an Overall Impact of ~ 10%**

**Care Time Metrics:**
1. Reduction in Total Cycle Time (TCT)
2. Reduction in Cycle Time by 40% through:
   - Minimization of WIP Work
   - Minimization of Non-Standard Work
   - Standardization of WIP Work
3. Reduction in Cycle Time Variation within ± 2.5% of Standard CI & ≥ 90% of TAKT Time
4. Equipment OEE to improve by ~ 35%

**Continuous Improvement**

**Highest Quality**

**Shortest Care Time**

**Affordable Cost**

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1. Business Case: Problem Defined

**Step – 1: Operational Efficiency Improvement**

**Intermediate Condition**

**Step – 2: Realizing Profitable Growth Competitive Advantage**
1. Business Case: Traditional Business Environment

- Business Internal Environment (World)
- Business External Environment (World)

Producer viewed as experts with one way delivery of product or service and communication.


- Going to Customer World (Toyota Model)
- Bringing Customer to My World (BMW / Lufthansa Teknik Model)

Toyota Sienna Project
- 153,000 Miles
- 20 Months
- 49 States (Kazuo Mori CE)

Voice of Customer (VOC) Models

The Resource Structure of Healthcare Organization

<table>
<thead>
<tr>
<th>Person Related Qualities</th>
<th>Qualities Related to the Physical and Administrative Care Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rationality</td>
<td>Medical – Technical Competence</td>
</tr>
<tr>
<td>Humanity</td>
<td>Physical – Technical Conditions</td>
</tr>
<tr>
<td>Identity Oriented Approach</td>
<td>Socio – Cultural Atmosphere</td>
</tr>
</tbody>
</table>

Source: Reproduced from Wilde et al. (1993) as published by Blackwell Science Ltd. www.emeraldinsight.com

1. Business Case: Services Business Environment

SIPOC (Supplier-Input-Process-Output-Customer) Model of Healthcare System

Process Steps:
1. Waiting / Reception
2. Initial Consultation
3. Tests / Diagnosis
4. Final Consultation
5. Prescription / Billing

Cycle Time

Quality Loss Function (Teguchi)

Source: Reproduced from Wilde et al. (1993) as published by Blackwell Science Ltd. www.emeraldinsight.com

Interrelationship Matrix

Process Flow

Patient Expectations

Competitive Benchmarking

Process Benchmarking

2. Data Collection: Direct Observations

Formal Quality Function Deployment Metric

Inter-relationship of Patient Expectations with Care Provider’s Process Steps

<table>
<thead>
<tr>
<th>Metric</th>
<th>Waiting</th>
<th>Initial Consultation</th>
<th>Diagnosis</th>
<th>Follow Up Consultation</th>
<th>Prescription</th>
<th>Billing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms</td>
<td>11°</td>
<td>5</td>
<td>9</td>
<td>3</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Recovery / Maintenance</td>
<td>5</td>
<td>3</td>
<td>11</td>
<td>7</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Affordability</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Accuracy</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>QOS</td>
<td>11°</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Total Weight</td>
<td>29°</td>
<td>19</td>
<td>35</td>
<td>27</td>
<td>43</td>
<td>31</td>
</tr>
<tr>
<td>Ranking</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

* Not actual scores; only relative importance based on AHP (Saaty)
2. Data Collection: Performance Metrics

Level I, II & III Metrics (Waiting Room Example)

Wait Time Trend Chart (Min)

Pain Itching BP Social Issues Others

Why Approach

Waiting Room Concerns (Level II)
Waiting Room Concerns (Level III)

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1. Data Collection: Performance Metrics

Wait Time Trend Chart (Min)

Perceptual Gap of Wait Time (9 Min / 31%)

Patients’ Perception: 38 Min
Clinic Goal: 29 Min

2. Data Analysis: Model Development

Time Perception at Different Places

ER Airport Fast Food Drive Through Bank Teller Fashion Mall New Car Showroom

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3. Data Analysis: Model Development

Value Stream Mapping Using Shikumi Diagram

3. Data Analysis: Model Development

Operational Area: Reception / Waiting

<table>
<thead>
<tr>
<th>Lean Tool Applied</th>
<th>Leverage Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice of Customer (VOC)</td>
<td>Better Understand Patient s’ Needs</td>
</tr>
<tr>
<td>Quality Function Deployment (QFD)</td>
<td>Prioritizing Patients’ Needs</td>
</tr>
<tr>
<td>Kano Model</td>
<td>Add Value to Patients’ Needs</td>
</tr>
<tr>
<td>Cycle Time Management (CTM)</td>
<td>Improve Patient Flow Through Downstream Processes</td>
</tr>
<tr>
<td></td>
<td>(Heijunka)</td>
</tr>
</tbody>
</table>

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### 3. Data Analysis: Model Development

#### Operational Area: Initial Consulting

<table>
<thead>
<tr>
<th>Lean Tool Applied</th>
<th>Leverage Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMED (Quick Changeover)</td>
<td>Quick Setup for Every Patients’ Exam</td>
</tr>
<tr>
<td>Check-Sheet / Std. Prep</td>
<td>Reduce Wait Time Before / After Exam</td>
</tr>
<tr>
<td>Best Practices SOP</td>
<td>Personalized Service</td>
</tr>
<tr>
<td>Well Documented Patient History (Koko Tora)</td>
<td>Shorten Exam Cycle Time (Heijunka)</td>
</tr>
</tbody>
</table>

#### Operational Area: Diagnostics / Pathology Lab

<table>
<thead>
<tr>
<th>Lean Tool Applied</th>
<th>Leverage Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Work (Best Known Method)</td>
<td>Improve Productivity and OEE of Equipment</td>
</tr>
<tr>
<td>Work Place Organization (WPO)</td>
<td>Reduce Excessive Motion</td>
</tr>
<tr>
<td>U Cell Layout</td>
<td>Improve Flow</td>
</tr>
<tr>
<td>Skill Development</td>
<td>Personnel Flexibility</td>
</tr>
</tbody>
</table>
### 1. Business Case: Lean Tools Vs. Leverage Opportunities

**Operational Area:** Final Consultation

<table>
<thead>
<tr>
<th>Lean Tool Applied</th>
<th>Leverage Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Setup</td>
<td>Eliminate Waste of Rework and Over-processing</td>
</tr>
<tr>
<td>Error Proofing <em>(Poke Yoke)</em></td>
<td>Avoid Prescription and Billing Errors</td>
</tr>
<tr>
<td>TPM</td>
<td>Establish Patients’ Return Visits / Maintenance</td>
</tr>
<tr>
<td>Visual Controls</td>
<td>Quicker and Effective Control</td>
</tr>
</tbody>
</table>

### 3. Data Analysis: Model Validation

**Inputs:**
- 6
- 6
- 3
- 3
- 1
- 7
- 4
- 2
- 9
- 8
- 5
- 1
- 7

**Diagnostic Lab Example:**
- Disposal
3. Data Analysis: Model Validation

Value Streaming 80/20 Procedures Combining With PERT

Inputs

Outputs

Total Cycle Time (Min)

4. Improvement Strategies: Enhancing Productivity

Opportunities for Improvement in Diagnostics Labs

1. Low OEE (30% ~ 35%)
2. Low Standard Work Content
3. Majority of Work Content Non-Standard – Non Value Added
4. High Rework Rate
5. Significant Opportunities for Overwork / Errors
4. Improvement Strategies: Error Reduction in Prescriptions and Billing

Operational Area: Prescription & Billing

<table>
<thead>
<tr>
<th>Lean Tool Applied</th>
<th>Leverage Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error Proofing (Poke Yoke)</td>
<td>Eliminate Waste of Rework and Over-Processing</td>
</tr>
<tr>
<td>Standard Work</td>
<td>Improve Uniformity of Work Cycle</td>
</tr>
<tr>
<td>Value Stream Mapping</td>
<td>Reduce Drug Costs</td>
</tr>
<tr>
<td>Kano Modeling</td>
<td>Enhance Patient Value</td>
</tr>
</tbody>
</table>

4. Improvement Strategies: Identifying Wastes

7 Wastes in Diagnostics Lab by Magnitude

- Motion: 43.50%
- Waiting: 31.40%
- Rework: 10.30%
- Overprocessing: 5.50%
- Defects: 4.80%
- Over Production: 4.00%
- Inventory: 0.50%
- Defects: 0.00%
- Over Production: 0.00%
4. Improvement Strategies: Eliminating Wastes

Traditional Model of Waste Identification and Elimination

Understanding & Eliminating Waste

Observe that 2 Things are ALWAYS happening concurrently.

Things that **should be** done  →  WORK

Things that **should not** be done  →  WASTE

*Limitation:* The model does not account for Operational Losses.

What About Slow Cycle Time and Non-Standard VA Work?

Enhanced Model of Waste Identification and Elimination

Foundation of Lean Enterprise

Source of Highest Variation Lean Enterprise

Waste but Quantifiable

Biggest Opportunity 17%

Value Added - Standard 27%

Value Added - Non-Standard 12%

Non-Value Added - Standard 21%

Non-Value Added - Non-Standard
4. Improvement Strategies: Eliminating Losses

**6 Big Losses – The Challenge**

- **Operating Rate**
  - Loading Time
  - Setup and Adjustment
- **Performance Rate**
  - Ideal Cycle Time
  - Net Operating Time
- **Quality Rate**
  - Total Produced - Scrap
  - Total Produced

**OEE Formulas**

- Loading Time
- Downtime
- In-process scrap
- Start-up Scrap

**O.E.E. = Operating Rate \times Performance Rate \times Quality Rate**

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**4. Improvement Strategies: Cycle Time Management**

**Capacity Constraints Analysis in Diagnosis Area**
4. Improvement Strategies: Cycle Time Management

Cycle Time Analysis & Productivity Improvement Strategy

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Average</th>
<th>Range</th>
<th>Standard Dev.</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>VA-STD</td>
<td>26.50</td>
<td>8.50</td>
<td>1.78</td>
<td>Maximize</td>
</tr>
<tr>
<td>VA-NSTD</td>
<td>20.63</td>
<td>29.77</td>
<td>8.10</td>
<td>Convert</td>
</tr>
<tr>
<td>NVA-STD</td>
<td>34.63</td>
<td>17.01</td>
<td>4.22</td>
<td>Compress</td>
</tr>
<tr>
<td>NVA-NSTD</td>
<td>17.27</td>
<td>32.23</td>
<td>6.52</td>
<td>Cut</td>
</tr>
<tr>
<td>TOTAL</td>
<td>99.03</td>
<td>53.01</td>
<td>13.47</td>
<td></td>
</tr>
</tbody>
</table>

5. Target Condition: Improved Layout

Target State: U-Cell Single Piece Flow With Sequencing

Main Flow Through Cell

5 6 7 8 9 10 11 1 2 3 4
5. Target Condition: Results

Target State: Improvement in All Four Elements of Work

1. Capacity Enhancement: Before improvement ~ 20% of the diagnostic work had to be outsourced @ 2.7 times the cost of in-house tests

2. Cycle Time Reduction: Diagnostic Process Time Reduced from 99.01 minutes to 38.51 minutes

3. Standard Work: Value Streamed SOP helped in Reducing Performance Losses

4. Layout: U-Cell Layout helped in reducing Motion Losses by 57.6%
6. Lessons Learned

- Principles of Lean Enterprise are equally effective in Product & Service Industry
- Customer in Service Industry have greater Role than Product Industry
- Lean Projects in Service Industry achieve superior results if the whole Operational Environment is Analyzed
- VSM demonstrate better results when investigated down to Level II & III

7. References
5. Strengths

- Expertise
- Experience
- Skills
- Qualification
- Business Understanding