The Caterpillar 6 Sigma Journey

Alfredo Garcia

2008
Caterpillar is ...

- The world's largest manufacturer of construction and mining equipment, diesel and natural gas engines and industrial gas turbines.
- Technology leader in logistics, construction, transportation, mining, forestry, energy and electric power generation.
Three Principal Lines of Business

- Machinery
- Engines
- Financial Products
Caterpillar by the Numbers

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (in billions)</td>
<td>$20.1</td>
<td>$44.96</td>
</tr>
<tr>
<td>Profit After Tax (in billions)</td>
<td>$1.1</td>
<td>$3.5</td>
</tr>
<tr>
<td>Earnings Per Share</td>
<td>$1.51</td>
<td>$5.37</td>
</tr>
<tr>
<td>Employment</td>
<td>68,440</td>
<td>100,000</td>
</tr>
</tbody>
</table>

**2008 EPS Outlook:** increase of 5 to 15 %
Global Value Chain….Global Complexity

- 278 Company facilities
- 198 Caterpillar dealers
- 1,689 Dealer branch stores
- More than 400 FG Wilson, MaK, Perkins and Solar distributors
- 1,437 Dealer rental outlets
- 3,000+ key suppliers

Company facilities
Cat dealers
FG Wilson, MaK, Perkins and Solar distributors
Cat dealer rental outlets not shown
DEFINING 6 Sigma
What is 6 Sigma?

- A **measurement** of variation
  - 3.4 defects per million opportunities – it’s near perfection
- A **method** for improving our processes
- The **disciplined application** of statistical tools

The higher the Sigma value, the lesser the chance of defects occurring
Reducing process output variation

- Product or Service Output
- Mean
- Critical Customer Requirement
- Variation

Defects: Service unacceptable to customer
6 Sigma is About Success

> **Relentless** quest for perfection to meet customer needs

> Data-driven, **fact-based** decision making

> **Focusing** your best people on your highest priorities

> Improving the **processes**

> **Rigorous alignment** of actions with strategy

> **Measuring** bottom-line impact

> **Transforming** how people work
DMEDI: Creation Process

- New products, services, processes
- Multiple tools and techniques
- Sustains long-term improvement
- Acts as an agent of change
DMAIC: Improvement Process

- “Real problems”
- Balance VOC and VOB
- Results in up to 4-6 months
- Multiple tools & techniques
- Sustains long-term improvement
- Acts as an agent of change
Does 6 Sigma Apply to Me?

- When there is an Output . . .
  *there is a Process*

- When there is a Process . . .
  *there is Performance Variation*

- When there is a Variation . . .
  *there is a 6 Sigma Opportunity*

6 Sigma can be applied to ALL functions, disciplines and business processes
6 Sigma AT CATERPILLAR
Global Launch of 6 Sigma – 2001

700 Business Leaders

Wave 1
- 300 Black Belts
- 1,000+ Green Belts
- 300 Business Leaders

Jan 22 Leadership Workshop

Wave 2
- 200 Black Belts
- 800 Green Belts

Feb 19 Leadership Workshop

Wave 3
- 100 Black Belts
- 400 Green Belts

May 7 Leadership Workshop

Wave 4
- 100 Black Belts
- 300 Green Belts

May 21

July 23

Sept 10

Black Belt & Green Belt Training
Global Deployment With Different Cultures

168 Dealers

More than 500 Key Suppliers

> Caterpillar Enterprise – January 2001
> Caterpillar Dealers & Suppliers – October 2001
> External scope over 10X greater than internal
# 6 Sigma Deployment Strategies

<table>
<thead>
<tr>
<th>Personnel Trained</th>
<th>Transformational</th>
<th>Functional</th>
<th>Targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everybody</td>
<td></td>
<td>Product and process designers</td>
<td>Strategically selected individuals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Content</th>
<th>Transformational</th>
<th>Functional</th>
<th>Targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview +</td>
<td></td>
<td>Overview +</td>
<td>Overview +</td>
</tr>
<tr>
<td>basic concepts, common fundamental tools, advanced tools</td>
<td></td>
<td>fundamental tools, advanced tools</td>
<td>specific methods &amp; tools</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Pros &amp; Cons</th>
<th>Transformational</th>
<th>Functional</th>
<th>Targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td>High awareness</td>
<td></td>
<td>Focused resources</td>
<td>High flexibility</td>
</tr>
<tr>
<td>Consistent methodology</td>
<td></td>
<td>Hard to deploy elsewhere</td>
<td>Isolation &amp; elitism for black belts</td>
</tr>
<tr>
<td>Common language</td>
<td></td>
<td>Limited commitment</td>
<td>No common language</td>
</tr>
<tr>
<td>Committed leadership</td>
<td></td>
<td>No common language across the organization</td>
<td>Lower initial investment</td>
</tr>
<tr>
<td>The way to do work</td>
<td></td>
<td></td>
<td>Can't integrate elsewhere</td>
</tr>
<tr>
<td>Higher initial investment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
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**Course Content**
- Strategically selected individuals
- Product and process designers
- Focused resources
- Hard to deploy elsewhere
- Limited commitment
- No common language across the organization
- High flexibility
- Isolation & elitism for black belts
- No common language
- Lower initial investment
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**Pros & Cons**
- High awareness
- Consistent methodology
- Common language
- Committed leadership
- The way to do work
- Higher initial investment
- Focused resources
- Hard to deploy elsewhere
- Limited commitment
- No common language across the organization
- High flexibility
- Isolation & elitism for black belts
- No common language
- Lower initial investment
- Can't integrate elsewhere
6 Sigma Roles

- Executive Leadership
- Deployment Champions
- Project Sponsors
- Process Owners
- Master Black Belts
- Black Belts
- Green Belts
- Yellow Belts

Employees that have completed 6 Sigma awareness training

CATERPILLAR: PUBLIC
DMEDI: Create new processes, products, services, and plants to 6 Sigma quality

DMAIC: Improve existing processes, products, services, and plants to 6 Sigma quality

Process Management: Leverage and sustain the gains achieved by improvement and creation
Our Recipe For Success — Guiding Principles

Follow the recipe with:

> Clarity
> Consistency
> Commitment
Committed Leadership

**HOW WE DEPLOYED**

> Leadership training expectations set at all levels
> Uniform message: Lead with clarity, consistency and commitment
> Formal leadership review structure

**WHAT WE LEARNED**

> Project sponsor engagement critical
> Risk of transferring leadership responsibility to Master Black Belts
> Commitment not enough…requires energy
Business Process Framework

**HOW WE DEPLOYED**
- 6 Sigma as the common operating system
- Consistent training and integrated curriculum for Black Belts and Green Belts
- Improvements are sustained through process accountability

**WHAT WE LEARNED**
- Global company, global needs—deliver training in language
- Process ownership was lacking
- Specialized training used to supplement core curriculum
# Customer and Market Network

<table>
<thead>
<tr>
<th>HOW WE DEPLOYED</th>
<th>WHAT WE LEARNED</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Voice of the Customer and Critical Customer Requirements defined and tied to outcome of the project</td>
<td>&gt; VOC tied to external customer</td>
</tr>
<tr>
<td></td>
<td>&gt; VOB tied to internal process partner</td>
</tr>
<tr>
<td></td>
<td>&gt; Need common global collection management process</td>
</tr>
</tbody>
</table>
Strategy Integration

HOW WE DEPLOYED
> Project selection aligned with enterprise and business unit strategies

WHAT WE LEARNED
> Utilize MGPP to manage scope
> Formal strategic alignment process to help select the right projects
> Project filters at CSF and SAI/KBA levels
> Projects run at enterprise and business unit levels
Full-Time 6 Sigma Team Leaders

**HOW WE DEPLOYED**
- Full time Black Belts reporting to Project Sponsor
- Full time Master Black Belts
- No direct reports for either BB or MBB

**WHAT WE LEARNED**
- Create velocity – 2 year assignment
- Maintained 10:1 ratio of MBB/BB
- Underutilized potential for Green Belt project leaders
- Include in normal succession planning process
Incentives & Accountability

HOW WE DEPLOYED

> Value creation through 6 Sigma rewarded and recognized

WHAT WE LEARNED

> Project-based rewards had limited impact
> Broader short-term incentive plans rewards helps focus attention
> Leadership discretionary pay linked to 6 Sigma
> Non-financial recognition is important
Quantifiable Measures & Results

HOW WE DEPLOYED
> Auditable measurement of value creation

WHAT WE LEARNED
> There is value in tracking both “hard” and “soft” benefits
> Black Belt density targets can lead to resource imbalance
> Important to create transparent link to business results
6 Sigma is about demonstrating results….

- **At the technical level** it is about using facts & data with proven analytical tools & methods to make better decisions in support of agreed upon requirements (VOC / VOB).

- **At an employee level** it is about developing people including Black Belts, Green Belts, Master Black Belts, and assigning them to work on the most important business issues.

- **At a project level** it is about following a rigorous proven change management & project management methodology that helps increase the rate for implementing change.
...and about ensuring sustainability

- **At a cultural level** it is about creating a more *process* oriented, proactive, customer-centric approach to running the business.

- **At a business level** it is about *alignment of resources to enterprise goals* and about delivering real / meaningful dollars to the bottom line.

- **At a leadership level** it is about *creating a vision for the future* and leveraging 6 Sigma methodologies as an *enabler* to ensure long term business objectives are met.
RELENTLESS EXECUTION OF STRATEGY
Caterpillar’s Strategy

VISION 2020

STRATEGIC PROFILE

STRATEGIC GOALS
People
Performance
Product & Process
Profitable Growth

CRITICAL SUCCESS FACTORS

PEOPLE
QUALITY
PRODUCT
VELOCITY
DISTRIBUTION
EMERGING MARKETS
TROUGH

ENTERPRISE STRATEGIC AREAS OF IMPROVEMENT

New Product Introduction
Order-to-Delivery
Encoding 6 Sigma
Sustainable Development
Growth Beyond Core

Our Values in Action – INTEGRITY, EXCELLENCE, TEAMWORK, COMMITMENT
WORLDWIDE CODE OF CONDUCT

6 SIGMA
CATERPILLAR: PUBLIC
To make the cultural transformation, 6 Sigma cannot be limited to project execution.
Best Practice - Lessons Learned

- Believe there is a compelling reason to change
- 6 Sigma is about the culture – tools are secondary.
- Deploy following the proven, best practices deployment strategy - speed is your ally.
- 6 Sigma must be deployed across the entire value chain to achieve the full potential.
- Develop a unifying 6 Sigma framework – replicate.
- What gets measured gets done – keep numbers real.
DELIVERING RESULTS
Strong earnings per share in 2007

2001: $1.30*
2002: $1.15
2003: $1.56
2004: $2.88
2005: $4.04*
2006: $5.17
2007: $5.37
# Performance Through 6 Sigma

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
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</thead>
<tbody>
<tr>
<td><strong>Cumulative Projects</strong></td>
<td>2,000</td>
<td>6,000</td>
<td>15,000</td>
<td>24,000</td>
<td>35,000</td>
<td>46,000</td>
<td>57,000</td>
</tr>
<tr>
<td><strong>Active Black Belts</strong></td>
<td>700</td>
<td>1,550</td>
<td>2,400</td>
<td>3,400</td>
<td>3,500</td>
<td>3,600</td>
<td>3,390</td>
</tr>
<tr>
<td><strong>Active Master Black Belts</strong></td>
<td>50</td>
<td>125</td>
<td>186</td>
<td>280</td>
<td>292</td>
<td>301</td>
<td>331</td>
</tr>
<tr>
<td><strong>Green Belts</strong></td>
<td>3,800</td>
<td>10,000</td>
<td>17,000</td>
<td>24,000</td>
<td>27,000</td>
<td>32,500</td>
<td>37,100</td>
</tr>
<tr>
<td><strong>Cumulative Supplier Deployments</strong></td>
<td>38</td>
<td>100</td>
<td>246</td>
<td>350</td>
<td>388</td>
<td>450</td>
<td>647</td>
</tr>
<tr>
<td><strong>Cumulative Dealer Deployments</strong></td>
<td>9</td>
<td>40</td>
<td>97</td>
<td>150</td>
<td>159</td>
<td>168</td>
<td>168</td>
</tr>
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</table>

Tremendous Progress since 2001
CPS and Vision 2020

Our Values in Action – INTEGRITY, EXCELLENCE, TEAMWORK, COMMITMENT
WORLDWIDE CODE OF CONDUCT
What is the Caterpillar Production System (CPS)?

The Caterpillar Production System is the common Order-to-Delivery process being implemented enterprise-wide to achieve our Safety, Quality and Velocity goals for 2010 and beyond.

It’s about:

- Applying a consistent set of standard processes
- Continuously improving processes through waste elimination
- Creating an environment to facilitate change and improve the way we work
- Creating the measurements and management structure that support continuous improvement
- Achieving breakthrough improvements
- Identifying challenges and determining what must change
- Creating a culture that shares successful practices and learns from mistakes
- Delivering on our promises – our 2010 strategic goals
3 Sub-systems and 15 Guiding Principles of CPS

**Operating System**
- Chase Waste: Drive for the continuous and relentless elimination of waste in all processes with priority on Safety and Quality related wastes
- Pull: Use Pull Replenishment to build only what is needed, when it is needed
- Make Value Flow: Simplify the processes to surface problems quickly and increase process efficiency
- Drive Standard Work: Standardized tasks and common processes are the foundation for Continuous Improvement
- Even the Load: Balance the workload to level production and mitigate demand variability
- Validate Our Processes: Prove the processes and technology work before introducing into production

**Cultural System**
- Put Safety First: Build a Safety First culture by placing the highest priority on eliminating safety related waste
- Take the Customer's View: Make decisions based on the customer’s view and the long-term Caterpillar strategy, even at the expense of near-term goals
- Go, See, Act: See it first hand to ensure thorough understanding
- Stop to Fix: Cease production when a problem occurs to correct it in process; this means we build-in station as planned
- Develop People: Identify, attract and develop people and teams to build Caterpillar’s long-term capability

**Management System**
- Actively Listen: Conduct Process Improvement Dialogues at all levels, demonstrating the value of people’s ideas by quickly implementing them
- Make it Visual: Build the visual workplace so no problems are hidden and opportunities can be realized
- Align the Targets: Deploy cascaded metrics and targets within Caterpillar and across the value chain aligned to the strategy supporting People, Quality, Velocity and Cost
- Act Decisively: Make decisions by consensus with a sense of urgency, thoroughly considering all options and implementing quickly
CPS unites the 3 Sub-systems - essential to continuous improvement

The Operating System is focused on waste elimination using 6 Sigma and 6 Sigma lean tools.

The Cultural System is focused on making change possible and improving the way we work.

The Management System is focused on creating the measurements and management structure to support Continuous Improvement.
8 Wastes

The ultimate goal of CPS is the elimination of waste. Waste is any activity that consumes resources, but creates no value for the customer.
17 Processes of CPS

Core

Demand Management
S&OP
Capacity Planning
Mfg. Engineering
Mfg. Support
Mfg. Production Execution
Orders Management
Supply Chain / Materials Management
Transportation
Finished Goods Dist.

Governing

Quality Management
Assessment and Governance
Environment, Health and Safety
Capability Building
Value Stream Transformation
Tools Development
Information Management

Enabling

Core

Governing

Enabling

6 SIGMA

CATERPILLAR: PUBLIC
6 Sigma is Foundational to CPS

CPS uses 6 Sigma:

- **Methodology** (DMAIC, DMEDI & Process Mgt.) supplemented with lean tools
- **Practitioners** (DCs, MBBs, BBs, & GBs) with additional CPS training
- **Full time job roles in defined salary grades** (BBs, MBBs, DCs)
- **Strategy Integration process** to align, prioritize, and select CPS projects
- **Financial Principles** to quantify CPS project benefits
- **Global deployment** with clarity, consistency, and commitment
6 Sigma VST Process

Prework

Find-It

Fix-It

Sustain-It

VST Planning

Current State Data Collection

Current State Analysis

Future State Design & MGPP

6 Sigma RIWs Quick Wins

6 Sigma Projects

Define → Measure → Analyze → Improve → Control
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>Holt &amp; Best Form Caterpillar</td>
<td>$14 – 52 Million</td>
</tr>
<tr>
<td>1930</td>
<td>Diesel Engine Emerges</td>
<td>$13 – 63 Million</td>
</tr>
<tr>
<td>1940</td>
<td>World War II</td>
<td>$73 – 255 Million</td>
</tr>
<tr>
<td>1950</td>
<td>U.S. Manufacturing Expansion</td>
<td>$394 – 742 Million</td>
</tr>
<tr>
<td>1960-70</td>
<td>Global Expansion</td>
<td>$716 – 7,618 Million</td>
</tr>
<tr>
<td>1980</td>
<td>Factory Modernization</td>
<td>$8.6 – 11.1 Billion</td>
</tr>
<tr>
<td>1990</td>
<td>Company-Wide Reorganization</td>
<td>$11.4 – 21 Billion</td>
</tr>
<tr>
<td>2000</td>
<td>6 Sigma Deployed Globally</td>
<td>$20.2 Billion</td>
</tr>
<tr>
<td>2005</td>
<td>Caterpillar Production System Launched</td>
<td>$36.4 Billion</td>
</tr>
</tbody>
</table>
“There’s no business challenge we can’t face when we unleash the talents of our people using 6 Sigma methodology to address them. The disciplines of 6 Sigma and the ingenuity of our people in applying them are a potent combination that give Caterpillar a unique opportunity to meet any business challenge that comes our way.”

-- Chairman and CEO Jim Owens