



Quality Systems & Improved Plant Design

A Presentation to the
Quality Modular Building Task Force

By

Dr. Ahmad Elshennawy, CQE

Dr. Mike Mullens, PE

Scott Broadway

October 5, 2001





Agenda

- HCL mission & organization
- Quality systems in the modular factory
- Innovations in modular manufacturing

Propose new applications of information technology on the shop floor



HCL Mission

The UCF Housing Constructability Lab (HCL) is a university-based research organization dedicated to creating production innovations for the U.S. homebuilding industry. The HCL will help homebuilders improve their ability to build high quality, affordable, energy efficient homes, provide service to our sponsors that exceed their expectations and provide challenging and satisfying research opportunities for students and faculty that will enhance their careers in professional practice and academe.





HCL Facilities

- New 500 ft² lab housed in Engineering II





HCL Research Staff

- 2 Faculty
- Students
 - 1 Ph.D
 - 3 Masters
 - 2 Undergrads

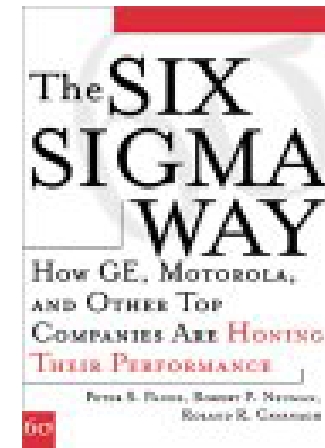
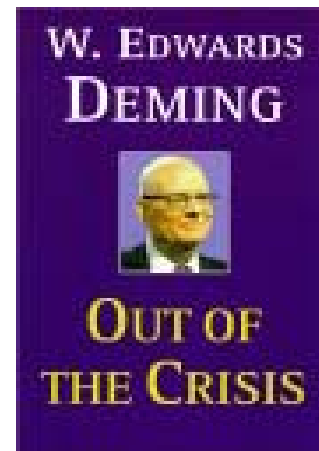
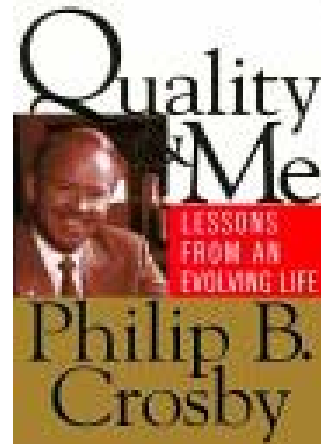
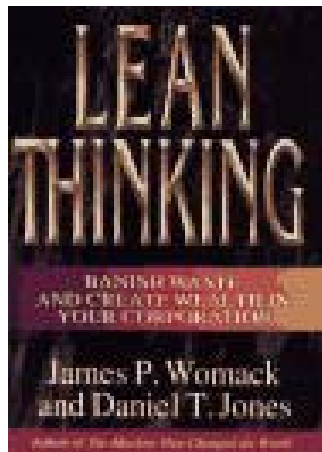


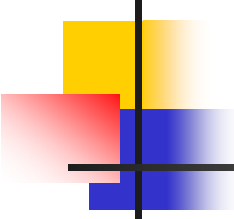


Quality Systems: Your Mandate

- “Recommend practical and useable quality control practices that can be used in modular manufacturing.”

The Literature





Approach: Benchmark Against Best in the Modular Industry

- Performed quality systems review at 5 modular manufacturers

Approach: Benchmark Against Best in Housing Industry

- Reviewed literature describing quality systems used by National Housing Quality Award winners
- Visited the 2000 NHQA Gold Level winner



Approach: Benchmark Against Best in Parallel Industries

- Visited 2 yacht manufacturers cited for quality



Approach: Benchmark Against the Best

- Attended Malcolm Baldrige National Quality Award conference and met award winners





Profile of Manufacturers

| Firm | Units/ Day | Mfg. Staff | Insp. | Mfg. Hr. Per Unit | Insp. Hr. Per Unit |
|---------|---------------|---------------|-------|----------------------|-----------------------|
| Mod 1 | 2.5 | 90 | 2 | 288 | 6.4 |
| Mod 2 | 3 | 90 | 4 | 240 | 10.4 |
| Mod 3 | 3 | 77 | 2 | 208 | 4.8 |
| Mod 4 | 5 | 130 | 3 | 208 | 4.8 |
| Mod 5 | 8 | 211 | 7 | 208 | 7.2 |
| HUD | 12 | 260 | 2 | 176 | 1.6 |
| Yacht 1 | 2 | 475 | 15 | 1904 | 60 |
| Yacht 2 | .5 | 45 | 6 | 720 | 96 |



Modular Manufacturers: Key Findings

- Say that quality is valued
 - Inspect for quality
- but*
- No coordinated pursuit of quality
 - Not obsessed with quality

Are we walking the talk?



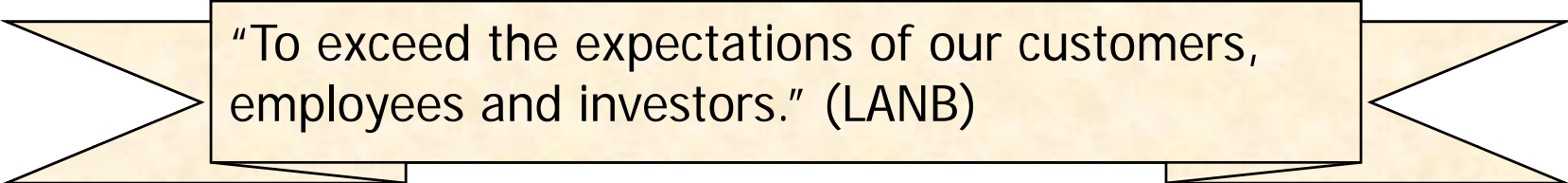
Best Practices: The Fundamental Concepts

- Recognize the overriding mission of satisfying your customers and the related need to satisfy your team members and owners
- Measure how well you are satisfying them
- Improve continuously and forever all product realization and associated business processes
- Empower your team members, giving them ownership of the improvement process
- Train your team members, providing skills necessary for success
- Recognize and reward your team members for success
- Lead by involvement

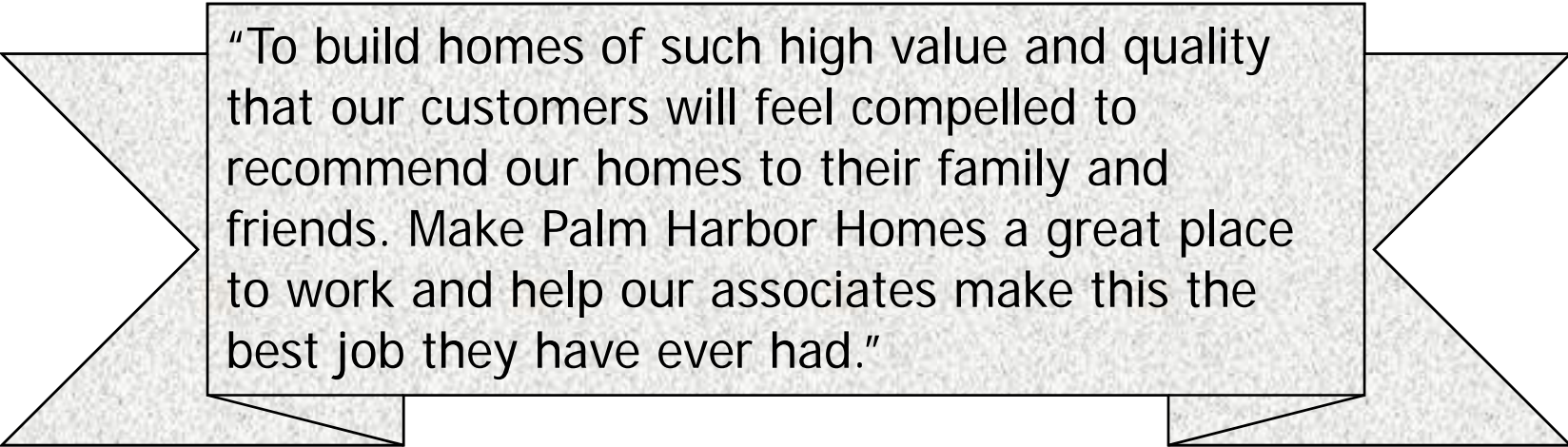
Walk the talk!



Best Practices: Mission Statement



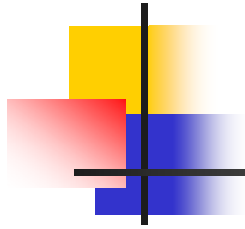
"To exceed the expectations of our customers, employees and investors." (LANB)



"To build homes of such high value and quality that our customers will feel compelled to recommend our homes to their family and friends. Make Palm Harbor Homes a great place to work and help our associates make this the best job they have ever had."

Best Practices: Mission Statement

- “Our mission is to be the best Modular Home Company in the business.
 - We will provide a quality product worthy of the American dream.
 - We will listen to our customer’s needs and provide the service and support they expect
 - We will recognize people as the major strength of the company
 - We will treat our customers and employees with integrity and fairness.” (Nationwide Homes)

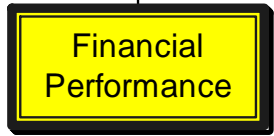
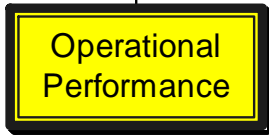


Best Practices: Measurement

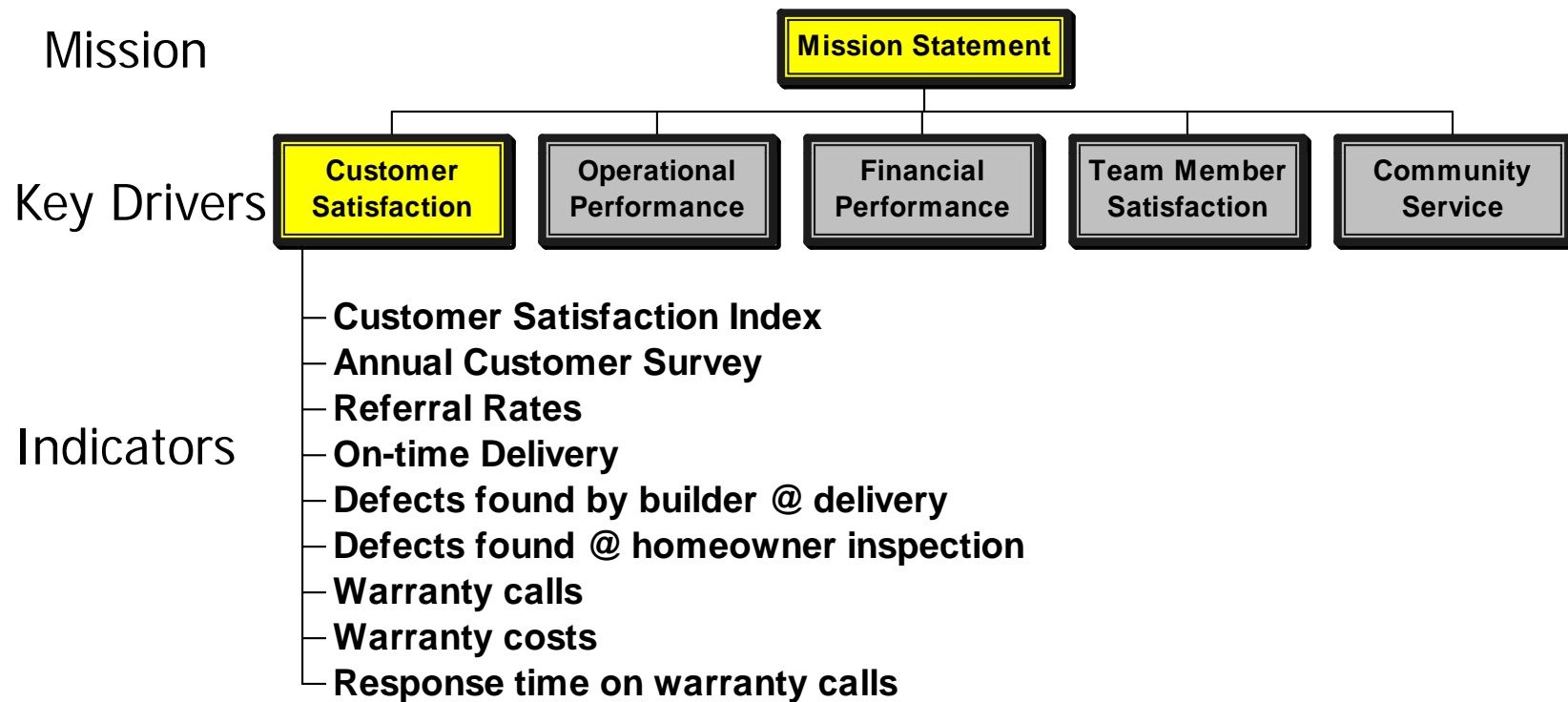
Mission



Key Drivers

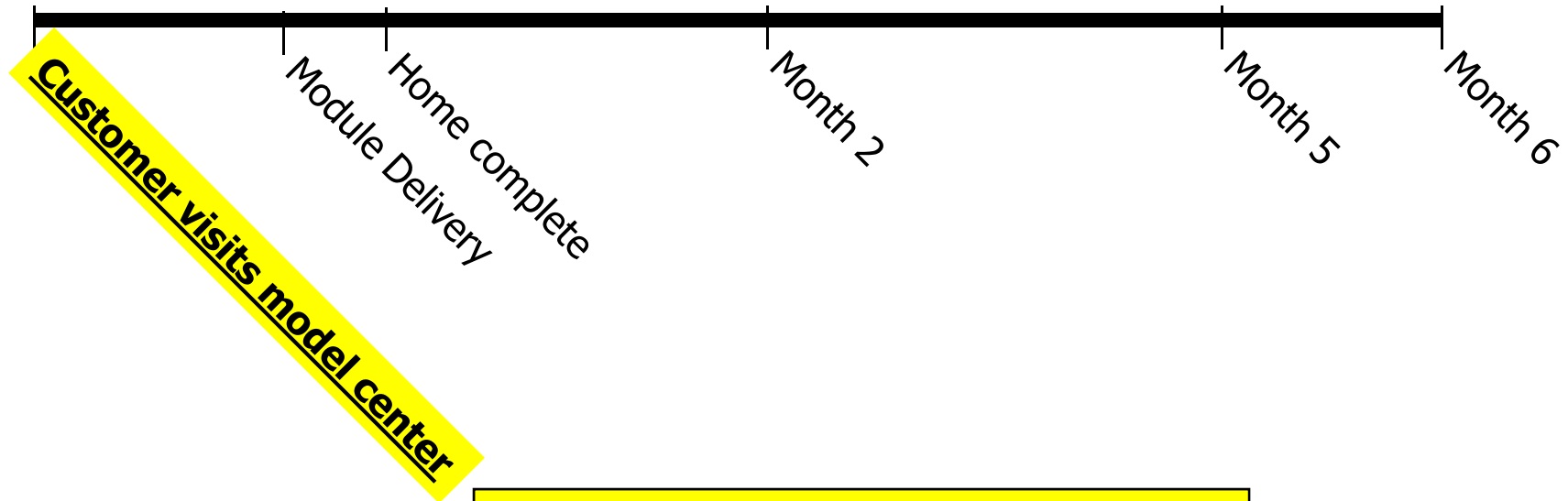


Best Practices: Measuring Customer Satisfaction



Best Practices: Measuring Customer Satisfaction

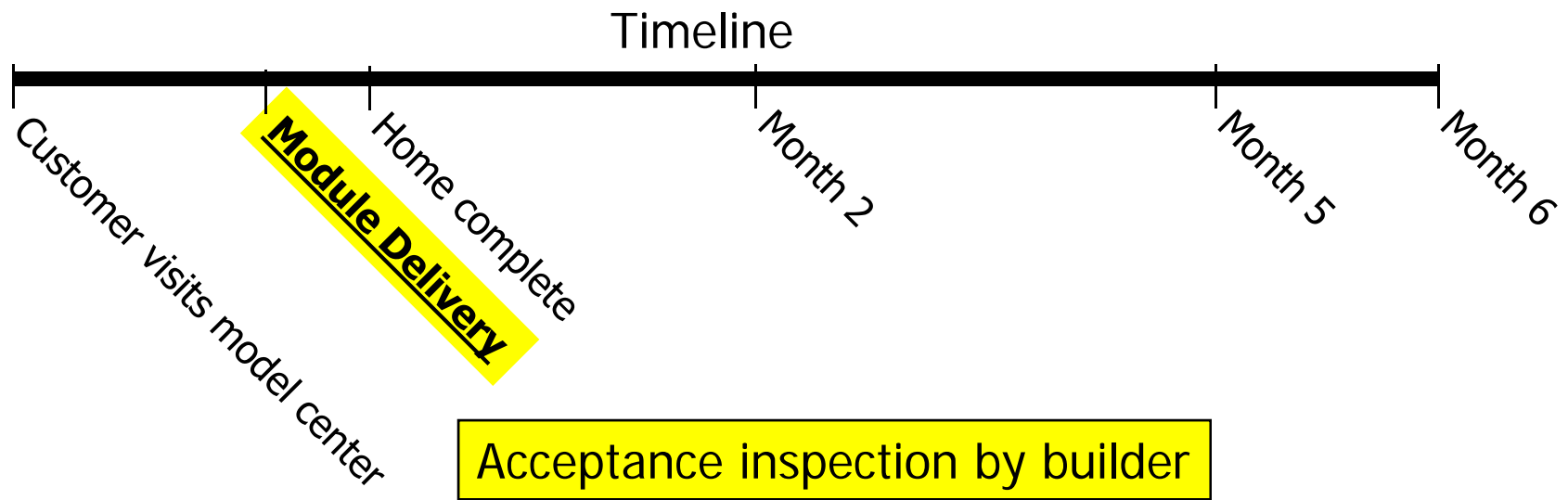
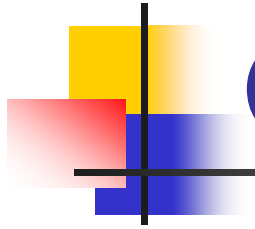
Timeline



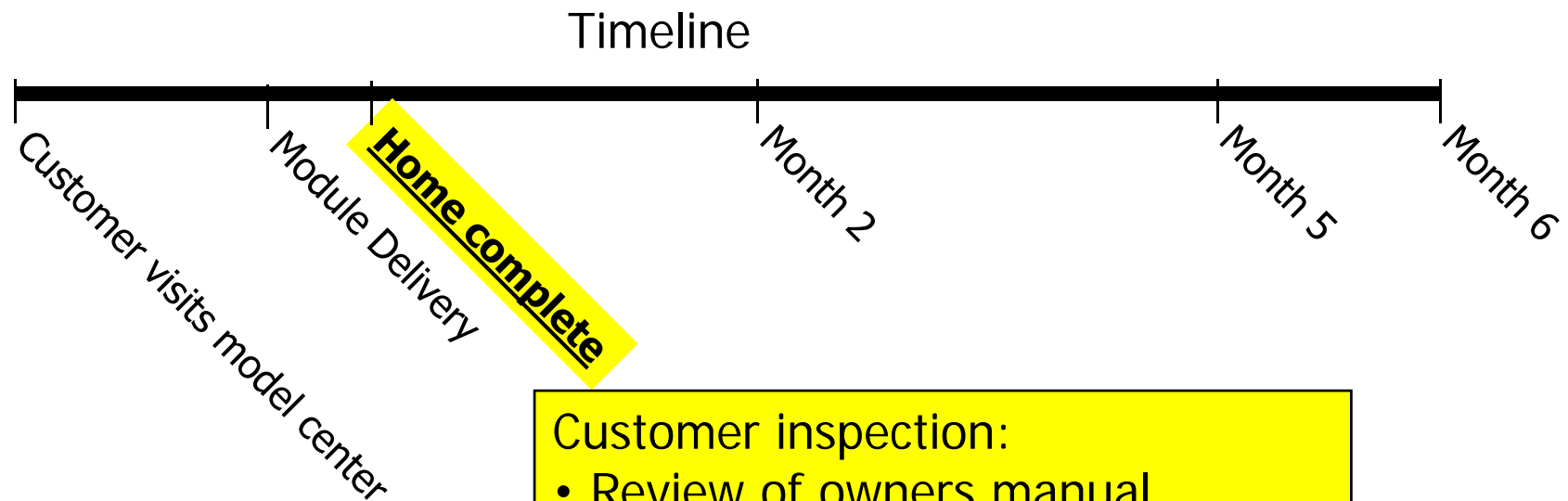
Survey:

- Impression of product
- Ideas for other goods & services

Best Practices: Measuring Customer Satisfaction



Best Practices: Measuring Customer Satisfaction

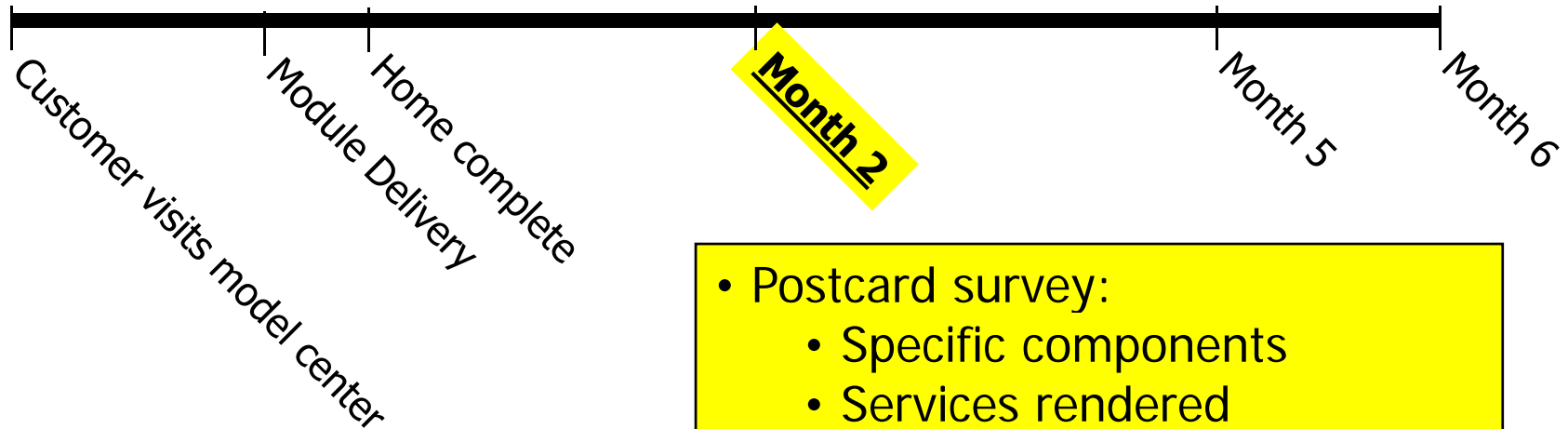


Customer inspection:

- Review of owners manual
 - Proper operation
 - Care & maintenance
- 200 point inspection
- Immediate correction of problems

Best Practices: Measuring Customer Satisfaction

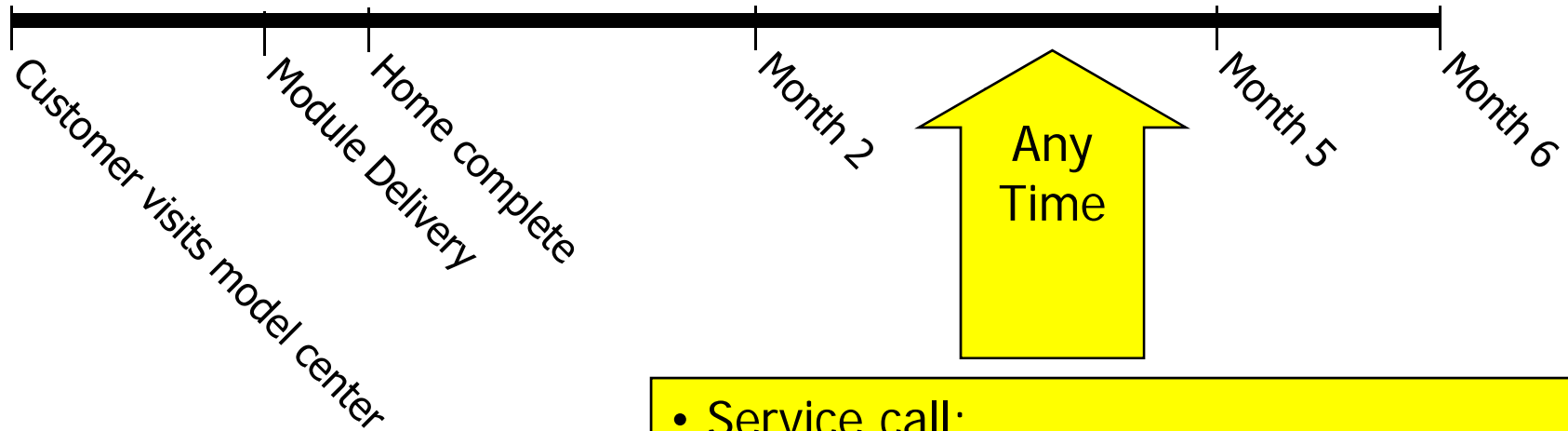
Timeline



- Postcard survey:
 - Specific components
 - Services rendered
- Customer Satisfaction Admin. call
 - Overall satisfaction
 - Unresolved issues

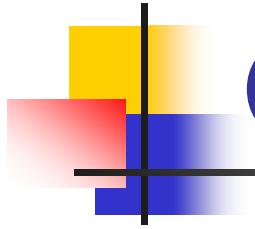
Best Practices: Measuring Customer Satisfaction

Timeline

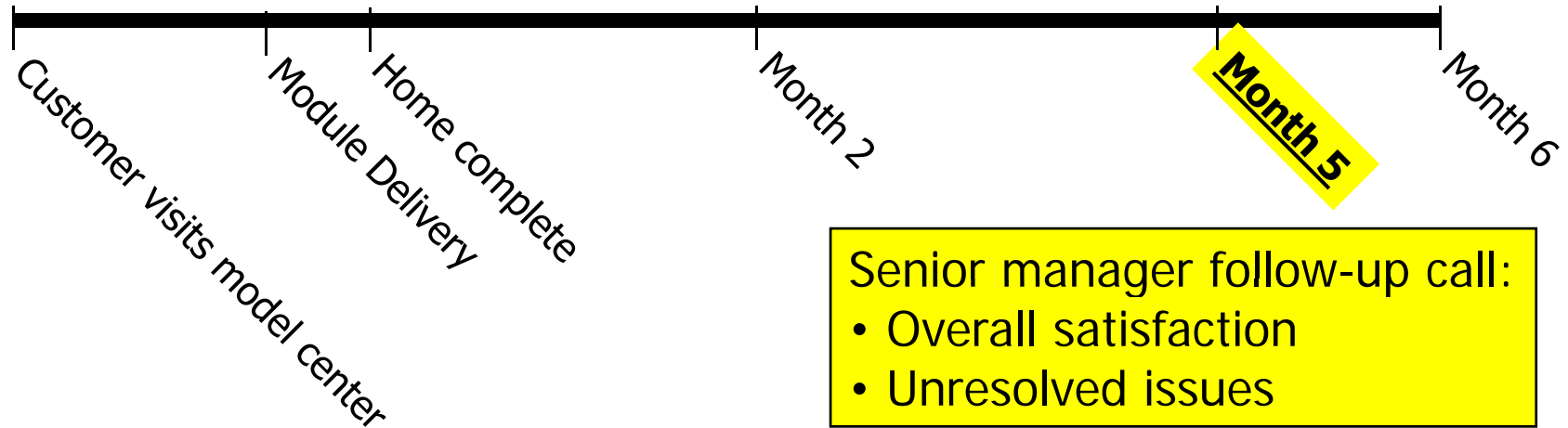


- Service call:
 - Coded and entered into computer
 - 24 hr. response for emergency
 - Weekly follow-up until complete
- "Direct Line" postcard to GM
 - Requires response

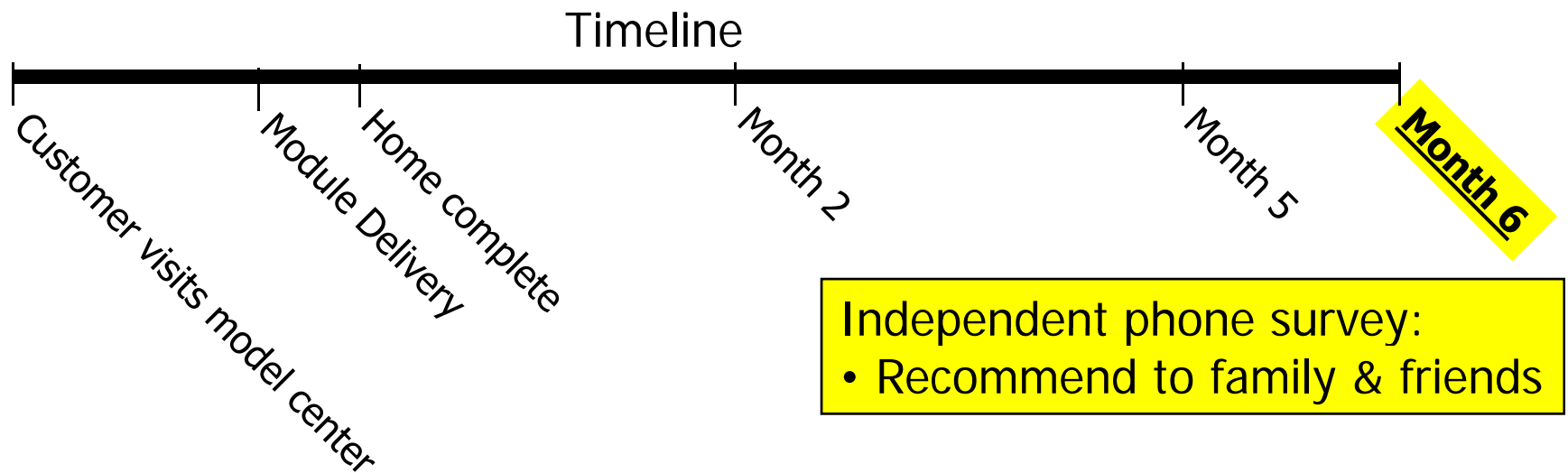
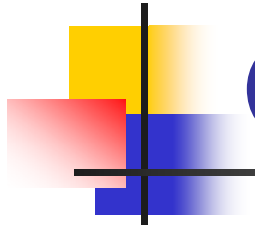
Best Practices: Measuring Customer Satisfaction



Timeline



Best Practices: Measuring Customer Satisfaction

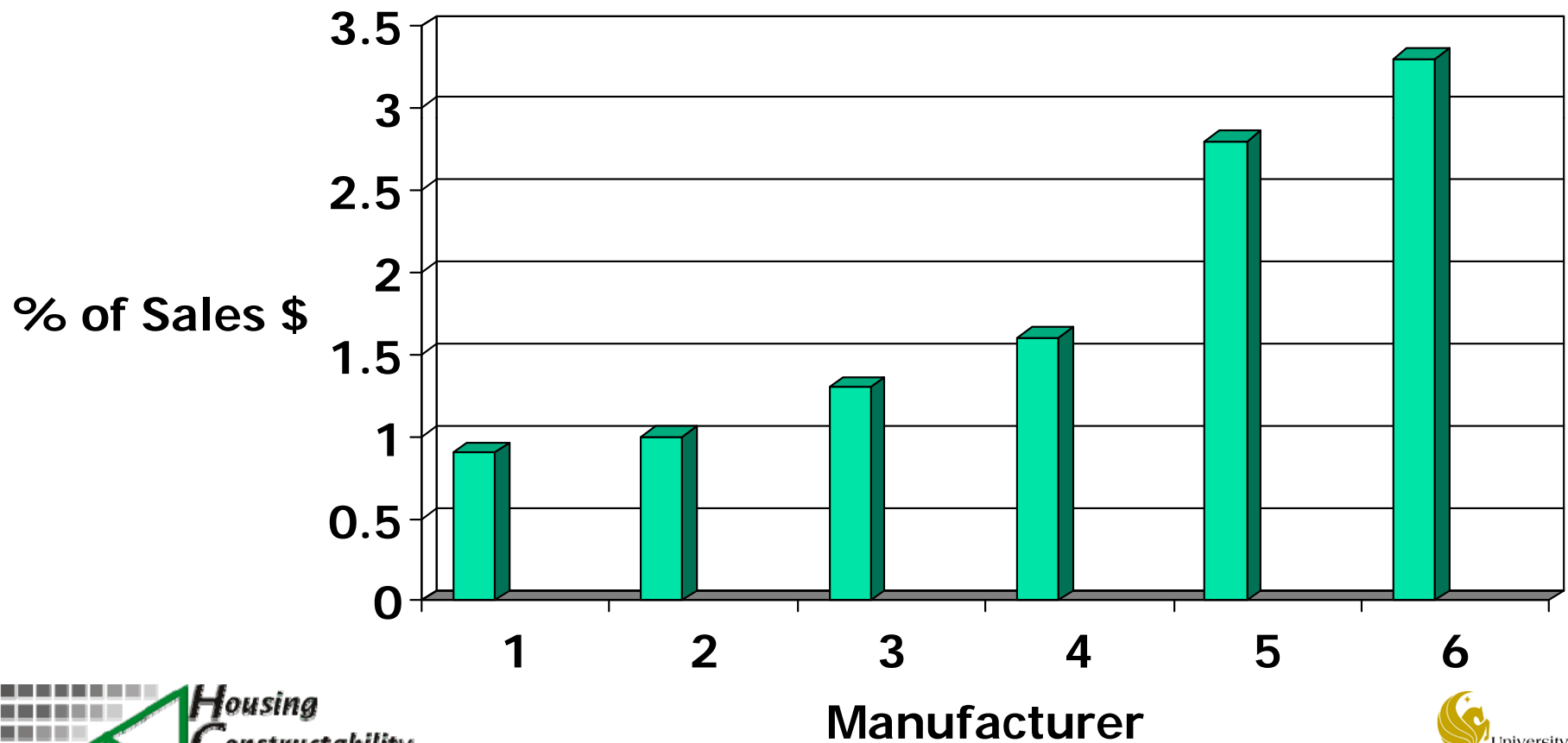




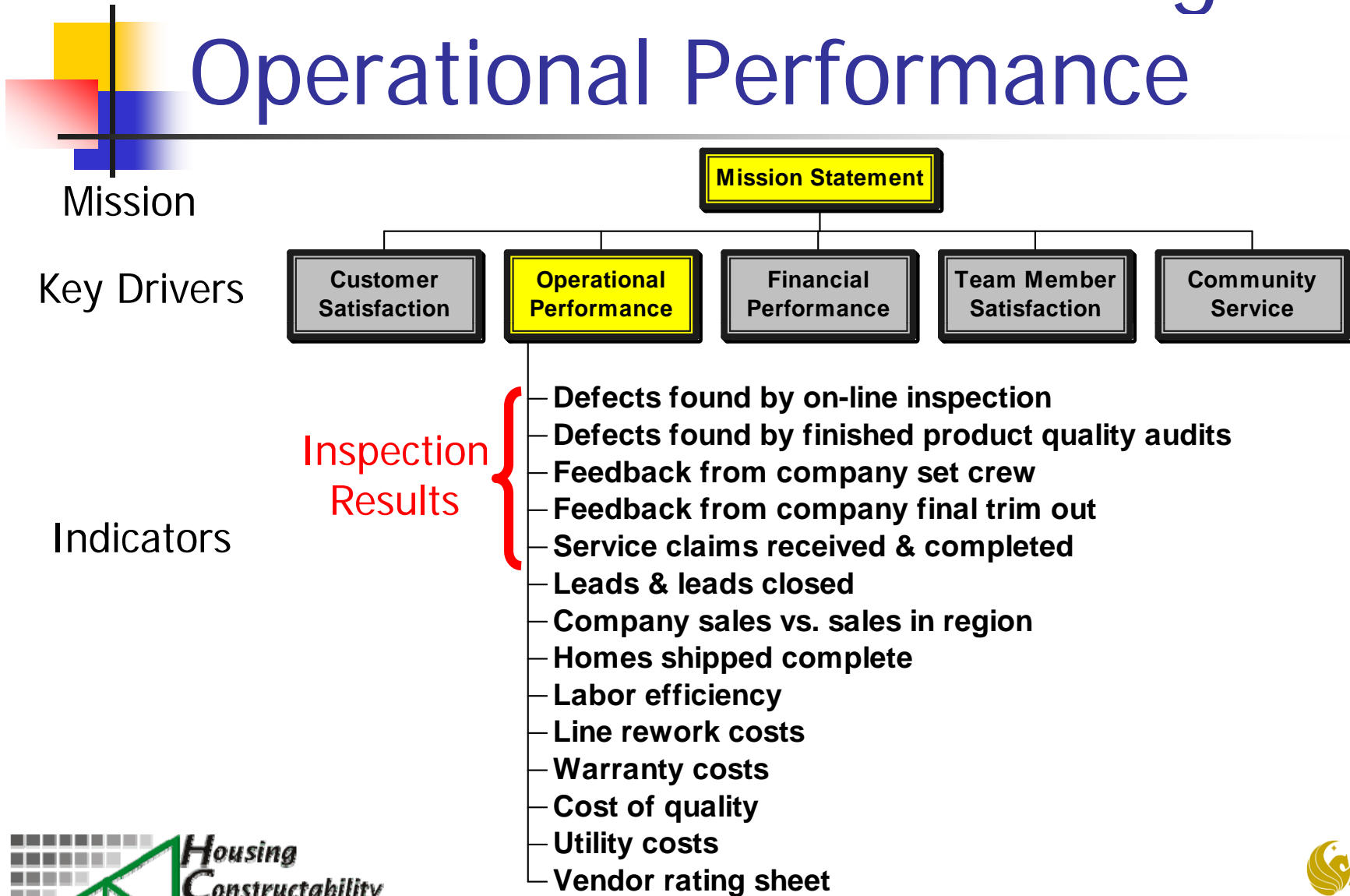
Best Practices: Measuring Builder Satisfaction

- Annual survey of builders
- Meet with builders 1-3 times each year
 - How are we doing?
 - What are you doing differently?
 - How can we help?
 - How we are responding?
- Senior management cruise with top builders

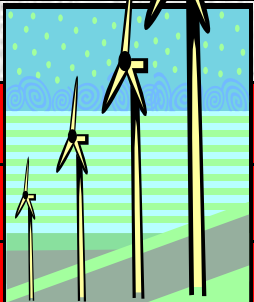
Customer Satisfaction: Service Cost Benchmarking



Best Practices: Measuring Operational Performance



Best Practices: Dimensions of Product Quality

| Product Life-Cycle Processes | Attributes of Product Quality | | | |
|------------------------------|-------------------------------|------------|--|-----------|
| | Architectural & Features | Structural | Functional | Aesthetic |
| Conceive/Sell | | | | |
| Engineer | | |  | |
| Manufacture | | | | |
| Construct | | | | |
| Service | | | | |
| | | | | |

 Critical Processes

Best Practices: Inspect for Product Quality

- Inspect for requirements – use checklist with desired attributes of product quality
- Inspect at process creating non-conformance
- Inspect by:
 - Dedicated QC inspectors
 - Production team members – self inspection
- Initiate corrective action immediately
- Document results & communicate for root cause analysis & continuous improvement

Best Practices: Special Product Inspections

- 3rd party inspection
 - Required by law
 - Most modules inspected
 - Focus on structural & code
 - Repeated non-conformance leads to increased inspections

Best Practices: Special Product Inspections (cont'd)

- Exit inspection
 - Modules not allowed to leave factory until complete (except for shortages)
 - Non-conformances documented & tracked until corrected
- Pre-shipment inspection
- Finished product quality audit
 - 1-2 homes weekly/monthly
 - Inspected by managers & volunteers
 - Results documented & drive continuous improvement & incentives

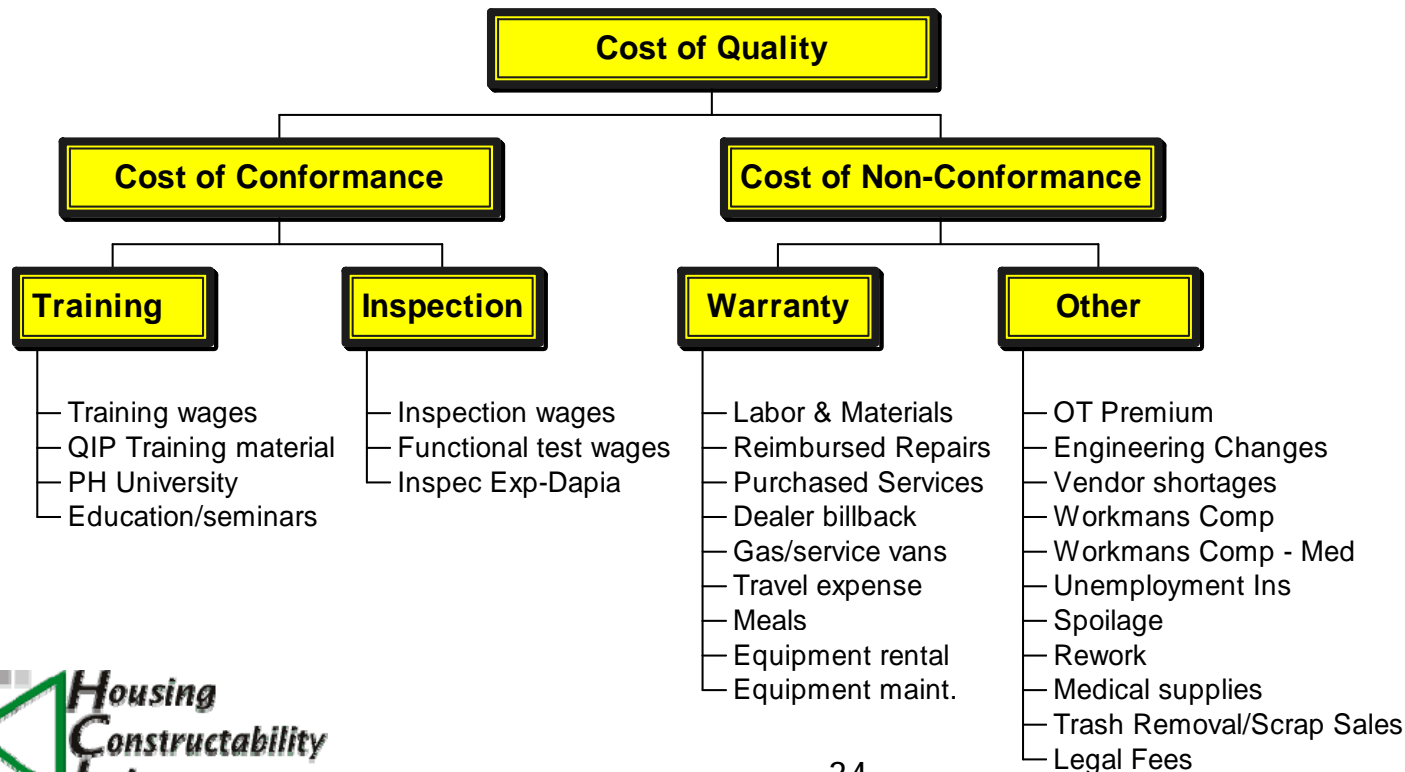


Best Practices: Other Inspections

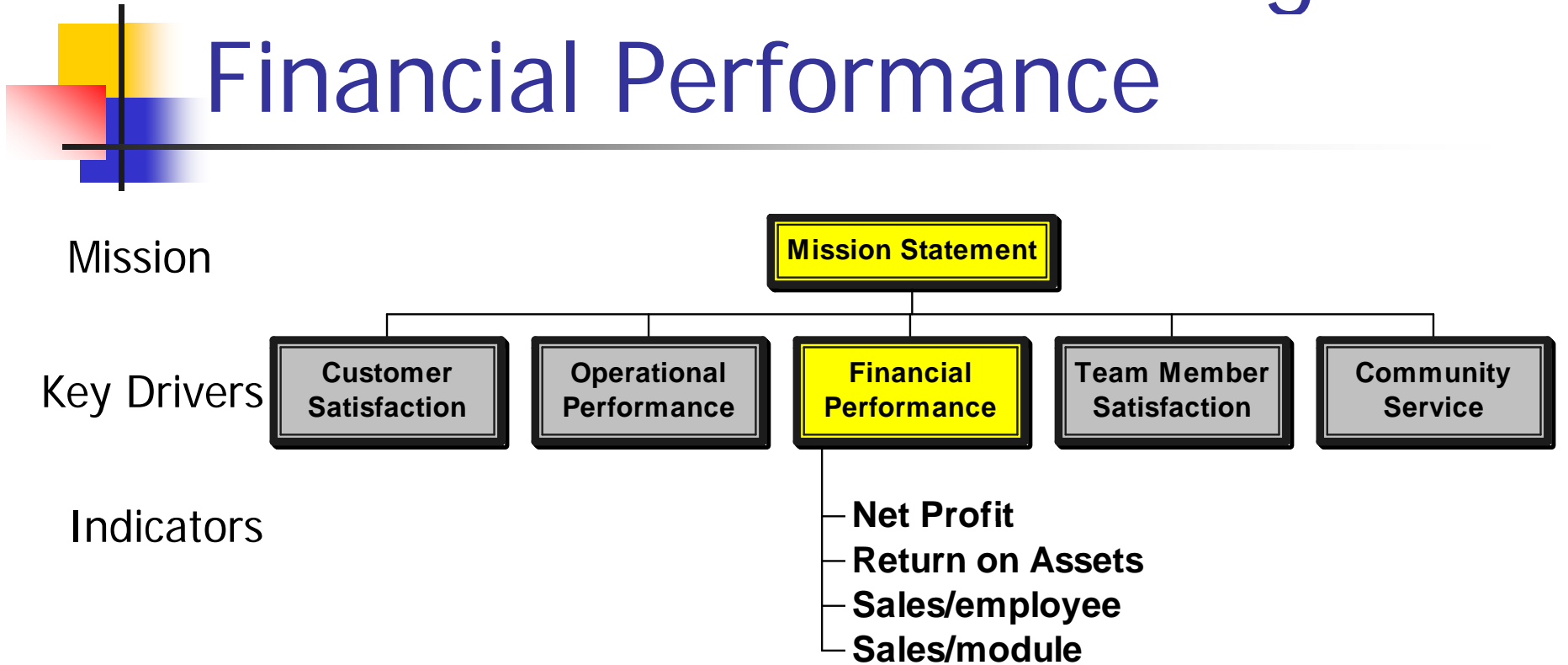
- Sales orders
 - Inspected by Engineering
 - Problems documented & sent back to sales
- Engineering drawings
 - Engineering managers check drawings at each stage
 - Drawings graded
- Received materials & components
 - Lumber – moisture content
 - Expensive components – tubs
- Shiploose inspection
 - Typically not performed by QC – undocumented

Cost of Quality

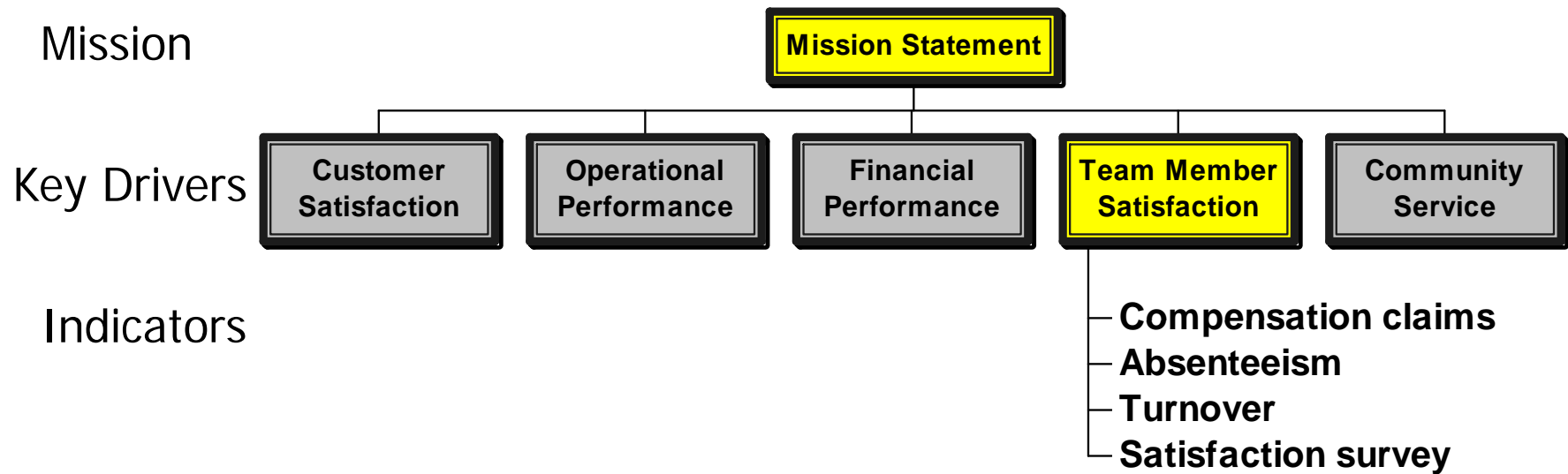
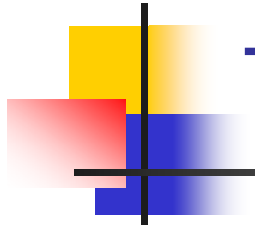
- All costs that would not be incurred if we built the perfect house.



Best Practices: Measuring Financial Performance



Best Practices: Measuring Team Member Satisfaction

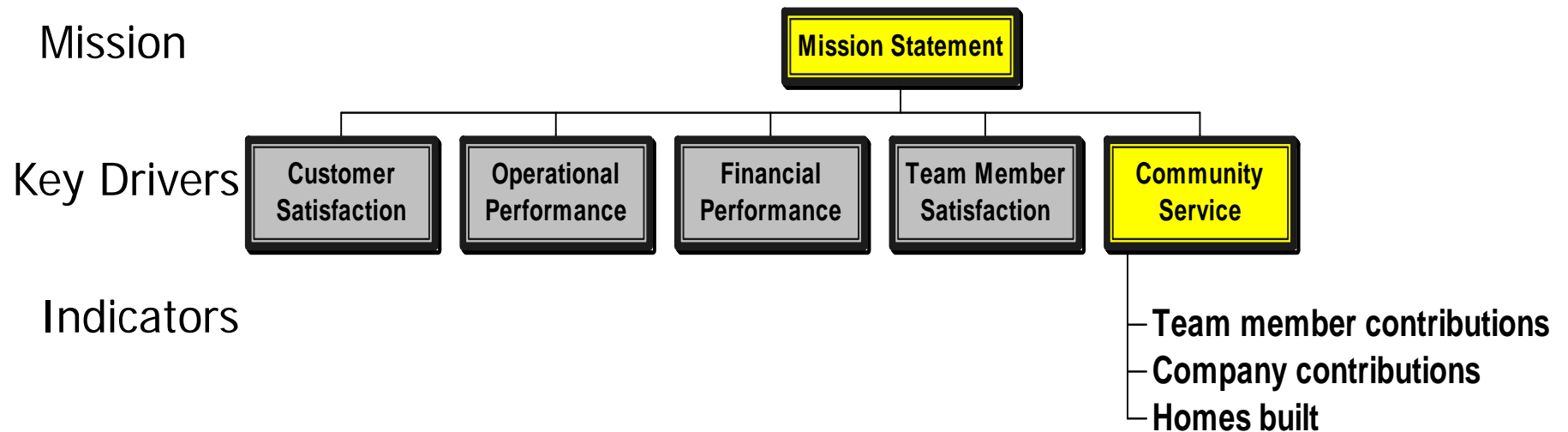




Best Practices: Measuring Team Member Satisfaction

- Annual team member satisfaction survey
 - All team members
 - 30-40 questions
- Quarterly survey
 - 1/4 of team members
 - Same questions
- Monthly Survey
 - Small sample of team members
 - Focus on likely dissatisfiers

Best Practices: Measuring Community Service

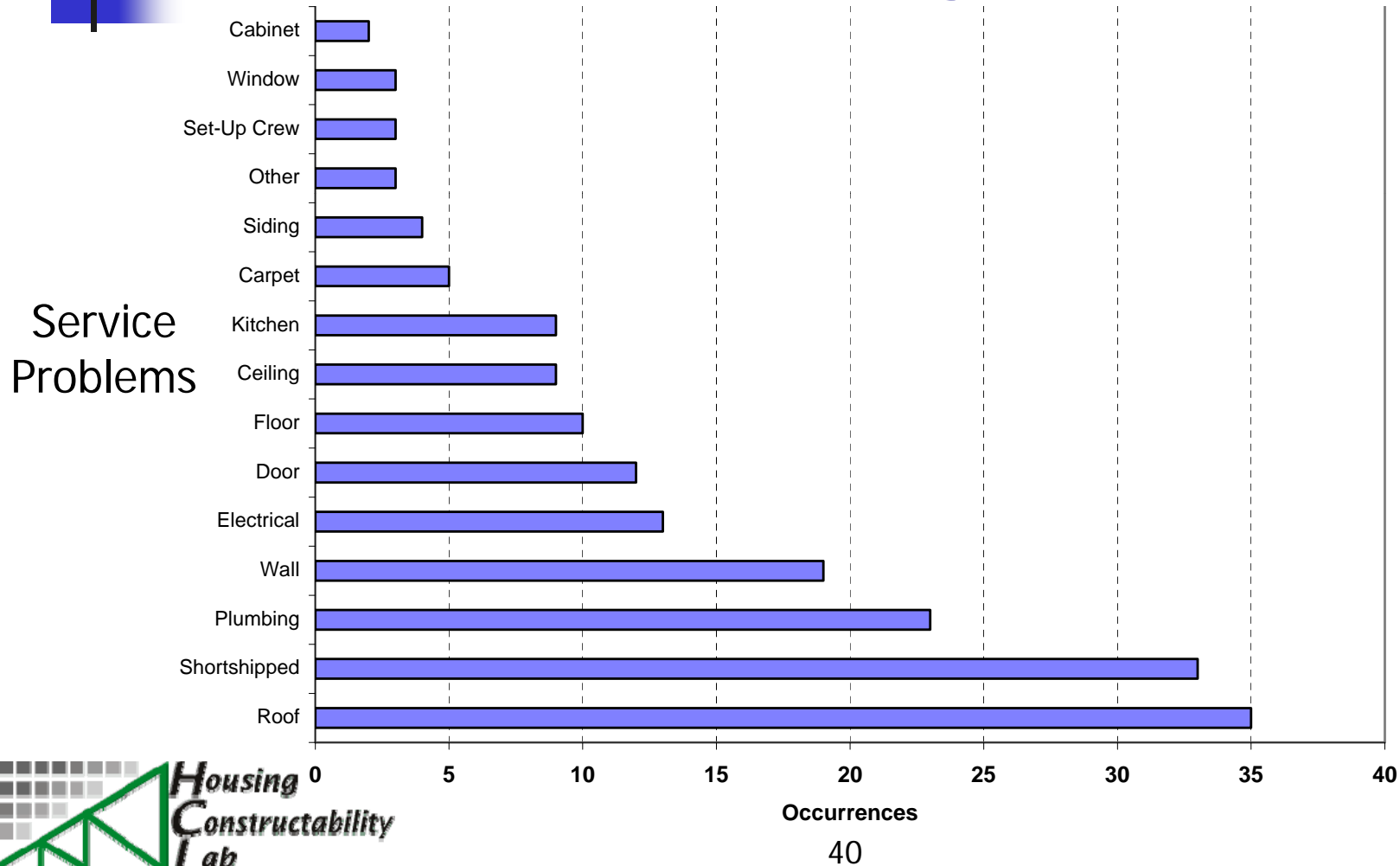




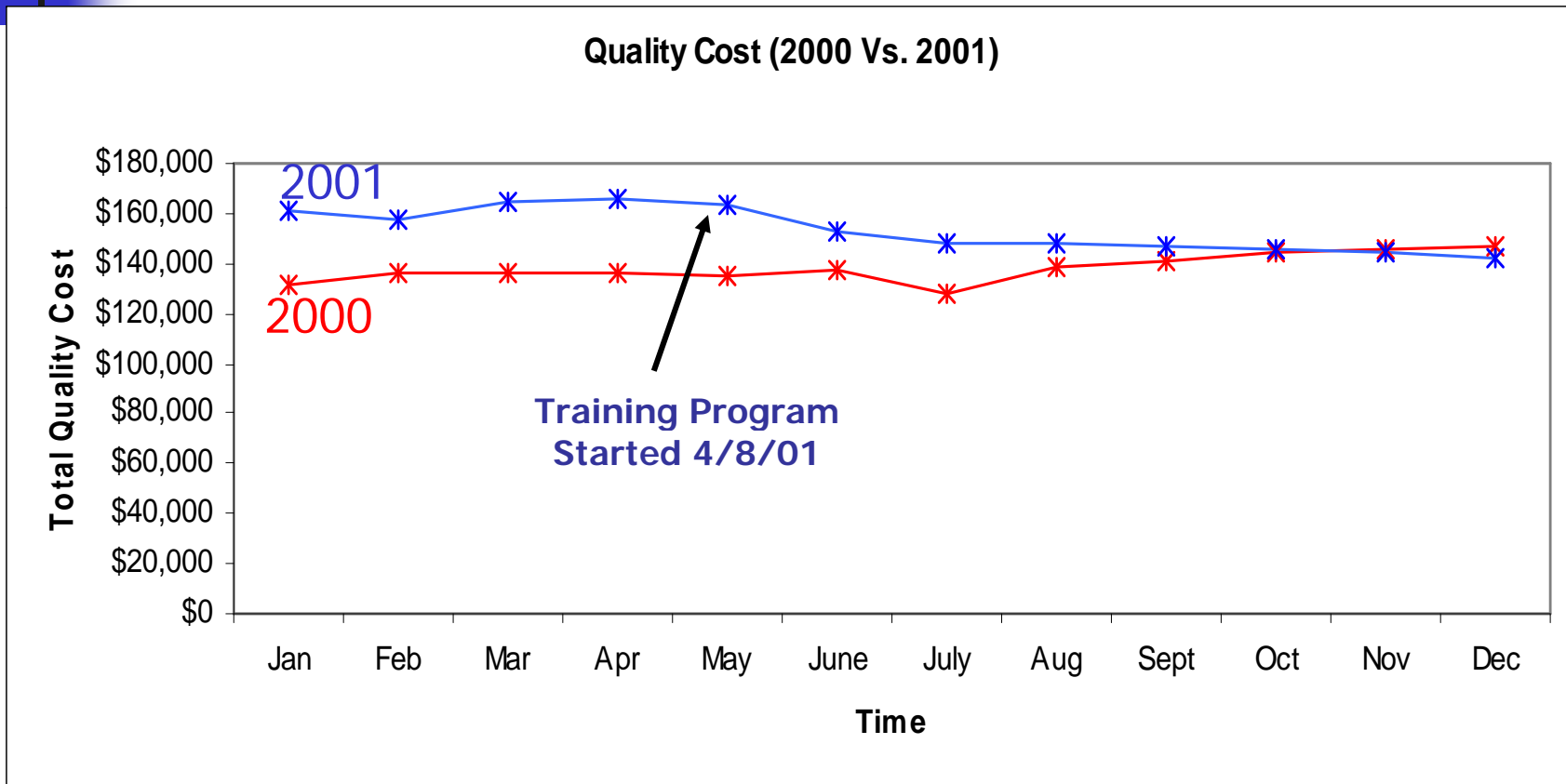
Best Practices: Measure Outside the Company

- Review best practices in trade magazines and conferences
- Send team members to competitor factories and sales locations to benchmark

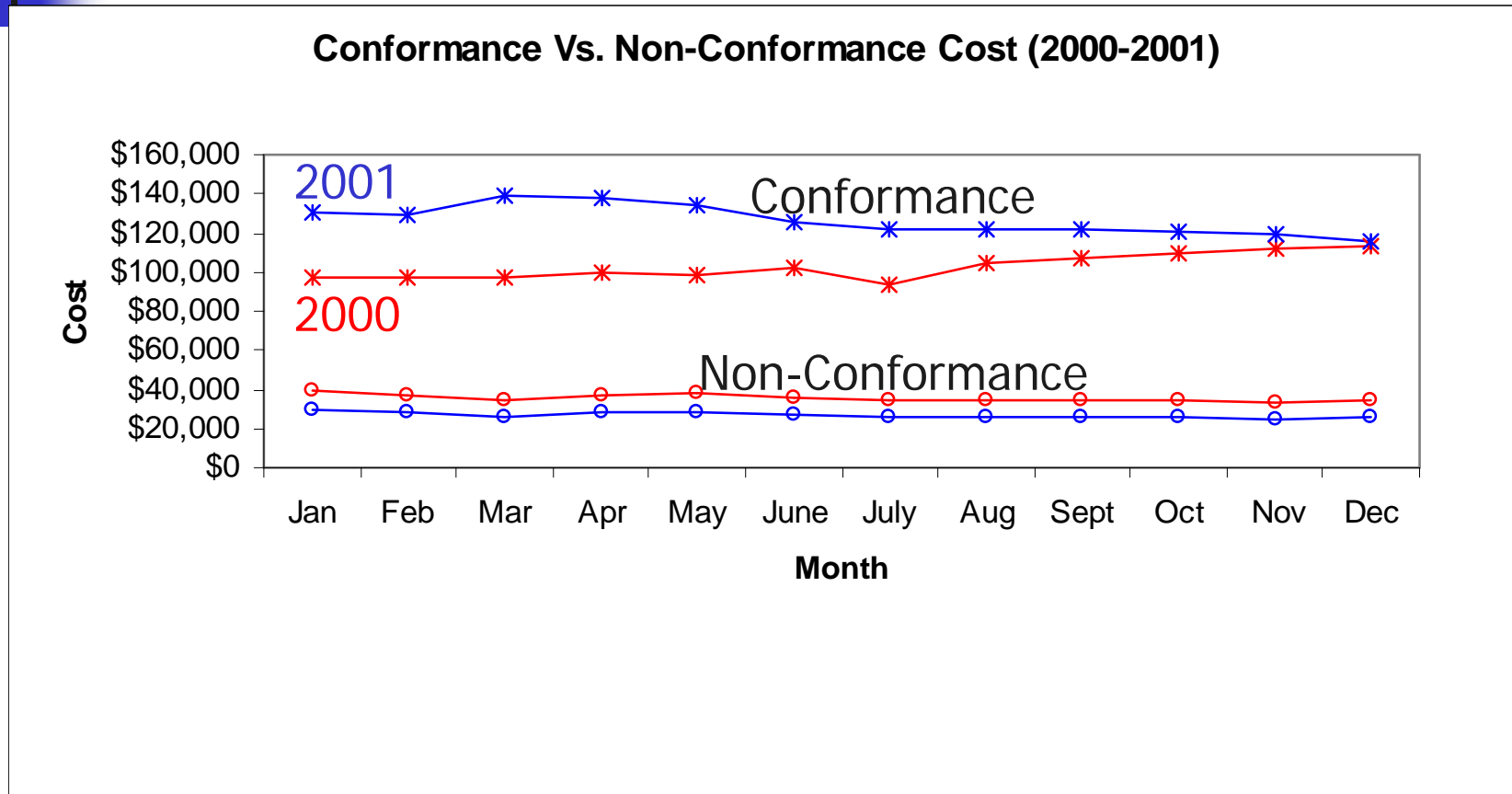
Best Practices: Identifying Opportunities Using Pareto Charts



Best Practices: Tracking Quality Using SPC Charts



Best Practices: Tracking Quality Using SPC Charts

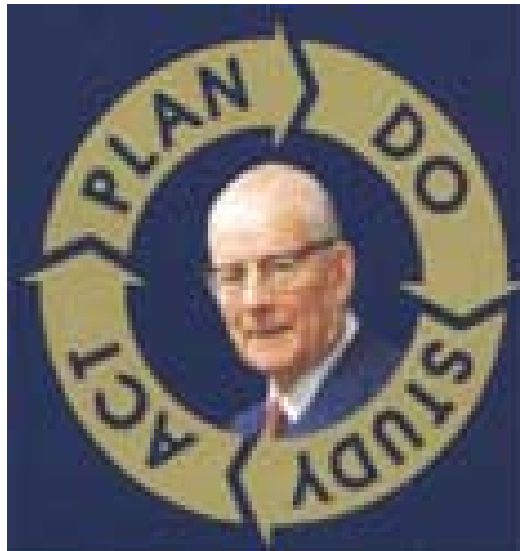




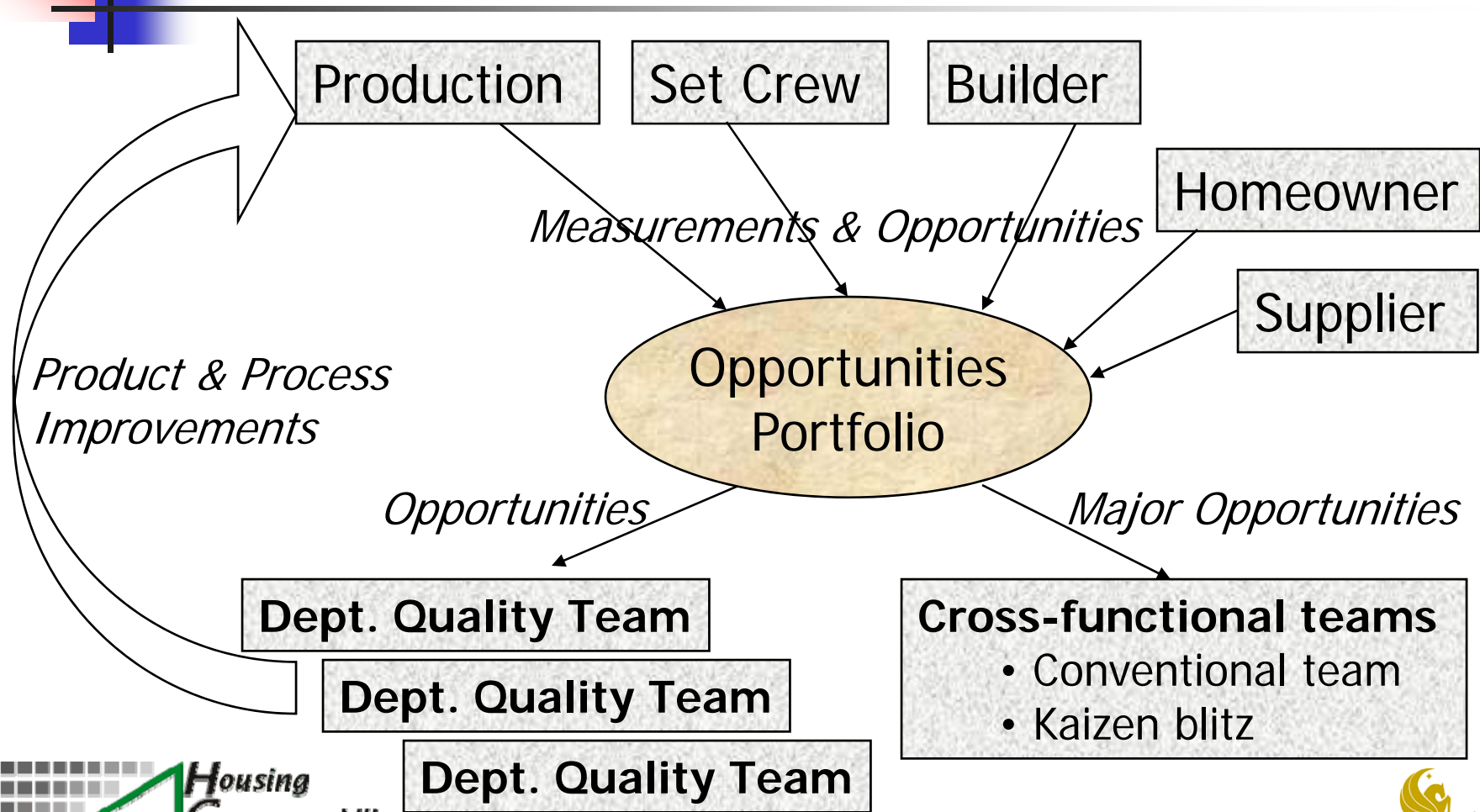
Best Practices: Presenting Measurements Using Balanced Scorecard

- Weekly/monthly scorecard indicating factors within span of control.
 - Units shipped complete
 - Labor efficiency
 - Turnover
 - Service claims received and completed

Best Practices: Continuous Improvement & Deming Cycle



Best Practices: Continuous Improvement





Best Practices: Involvement in Continuous Improvement

- Engineering
 - Use service call data to ID and solve problems caused by engineering – *reduce problems 33%*
 - Use QC form to notify engineering of non-conformances they caused on production line
- Customer service
 - Each service tech spends week in plant each year working directly on customer dissatisfaction issues



Best Practices: Involvement in Continuous Improvement

- Suppliers

- “Quality walks” - monthly or quarterly factory inspection by suppliers to find better ways to install their products – *\$8M savings*
- Document and track vendor-related shortages & claims - expect improvement



Best Practices: Scope of Continuous Improvement

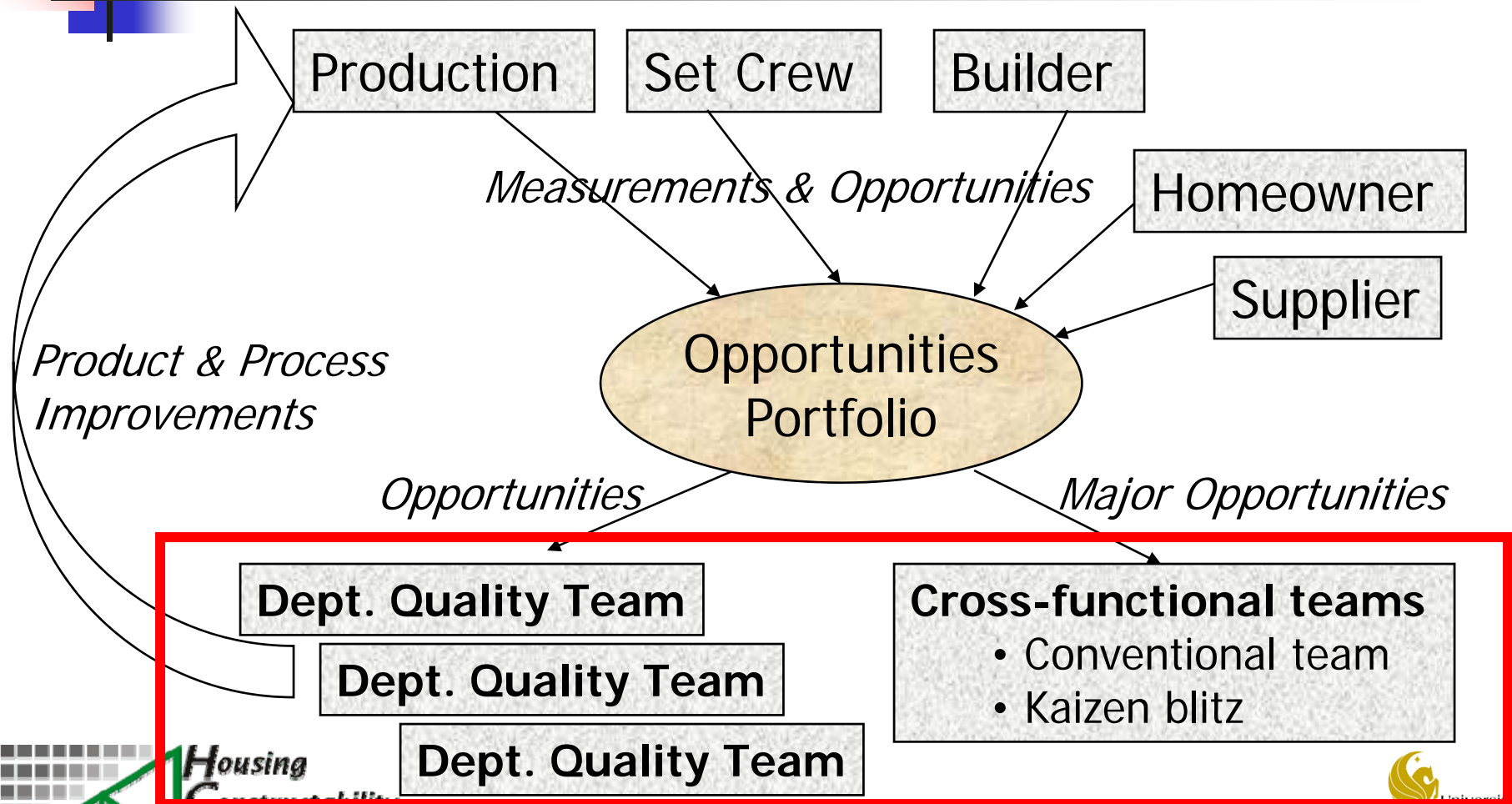
- Continuous improvement involves developing *new products* as well as better processes
 - Listen to customers & develop value added features w/ high value points that competitors are reluctant to imitate – manufacturer now finishes their homes
 - Involve suppliers, outside sales people, and production team members when designing new homes



Best Practices: Attitudes Toward Continuous Improvement

- After winning National Housing Quality Award, manufacturer pursuing ISO 9000 - as a learning exercise
- "Our management style focuses on prevention. Everyone in company is working toward common purpose of eliminating non-conformances. Our attitude is zero defects."

Best Practices: Team Member Empowerment





Best Practices: Team Member Empowerment

- Departmental quality teams
 - Objective – Improve safety, quality, timeliness and cost in the workstation
 - Candidate opportunities – Limited scale, measurable
 - Participation & leadership
 - Employees required to participate - 4-12 employees/team
 - Team leader - department group leader
 - Coach – department supervisor

Best Practices:

Team Member Empowerment

- Departmental quality teams (cont'd)
 - Schedule - Formal weekly meetings (15-25 minutes) + informal time
 - Approach – Plan-do-study-act; root cause analysis
 - Authority – Implement change & spend up to \$100 per opportunity with no question
 - Disengagement from issue
 - After measurement shows that improvement is sustained (4 weeks)
 - Conclude with celebration



Best Practices: Team Member Empowerment

- Cross-functional quality teams
 - Objective – Improve safety, quality, timeliness and cost company-wide
 - Candidate opportunities – broad-scale, measurable (examples, shortages, flat/level)
 - Participation & leadership
 - Volunteers
 - Experts, including suppliers
 - Coach – Senior staff



Best Practices: Team Member Empowerment

- Cross-functional quality teams (cont'd)
 - Approach
 - Conventional team
 - Plan-do-study-act
 - Extended timeframe
 - Kaizen blitz
 - Plan & implement
 - One week, full-time
 - Authority – Implement change



Best Practices: Team Member Empowerment

- Special purpose teams
 - Quality council
 - Senior staff
 - Facilitates entire quality effort; prioritizes opportunities
 - Finish team
 - Observes finish process for 2 homes each month
 - Collects data & identifies opportunities
 - Survey Committee
 - Managers and team members
 - Sub-committees work top 5 issues in employee surveys



Best Practices: Team Member Empowerment

- Special purpose teams (cont'd)
 - Cost walks
 - Annual event
 - Saturday
 - Suppliers and team members spend all day reviewing processes and generating opportunities
 - This year - 500 opportunities - \$150k savings



Best Practices: Team Member Training

- Hire new team members with right attitude & capabilities (all Baldrige winners)
- Provide structured OJT, close supervision & periodic evaluation of new team members
 - Use an instructional outline indicating key learning outcomes for each plant job
 - Provide group leader/supervisor check-off to assure key learning outcomes are attained
 - Evaluate performance weekly for 1st several months



Best Practices: Team Member Training (Cont'd)

- Provide quality training for new team members
 - Senior managers lead series of quality classes – 16 hr.
 - Topics - define quality, need for requirements, how to write them, need for prevention/improvement, how to improve processes through quality teams
- Encourage and reward cross-training
 - Maintain skills profile for all team members - use for production planning and career planning
- Focus on training during slow months – not firing



Best Practices: Team Member Training (Cont'd)

- Provide ongoing educational opportunities
 - On-site language instruction - English for Spanish speaking & Spanish for English
 - On-site GED & college credit classes
 - \$1,500/year tuition benefit



Best Practices: Group Leader & Supervisor Training

- Group leaders
 - Company/local college provide 10 weeks of front line leadership training – team member time
- Supervisor training courses
 - Additional 10 weeks coaching & mentorship training
 - Successful Supervision
 - Teamwork & Empowerment
 - 7 Habits of Highly Effective People (Covey)



Best Practices: Other Training

- Inspectors
 - Set visits – observe & discuss frequent problems with set crew & builder
 - Builder visits factory to train inspectors
- Customer service – satisfying the customer
- Suppliers
 - Require vendor participation in quality education
- Set crews – provide regular training



Best Practices: Builder Training

- In plant training
 - 2 days at plant
 - All departments participate
- New builder consultant
 - Assists builder during 1st modular project
 - From sales to set & finish
- Service assistant
 - On-site during complex sets



Best Practices: Recognition Programs

- Team member recognition
 - Team Member of the Month
 - Quality Person of the Month
 - Team Leader of the Quarter
 - Perfect Attendance Recognition
- Team recognition
 - High Performance Team of the Month
 - Successful project completion – meet zero defects goal for 4 weeks

Best Practices: Hourly Team Member Reward Systems

- Supplement base pay with bonuses
 - Base pay - % of sales
 - Varies by department
 - Incentive for department to reduce team members or finish early
 - Hourly bonus based on finished product quality audit
 - Audit targets current problems
 - Paid to all team members
 - Hourly bonus based on other measures
 - Meet goals on turnover, rework, accidents, OT, suggestions
 - Paid to all team members
 - Hourly bonus based on individual attendance

Best Practices: Hourly Team Member Reward Systems

- Annual bonuses
 - Bonus type
 - Hourly kicker – based on CSI
 - Bonus – based on meeting customer service \$ goal
 - Savings bond – based on finished product quality audit
 - Must be employed at year end
 - Paid to all team members

Use results from team member surveys to guide incentive system structure

Best Practices: Other Reward Systems

- Group leader - Hourly bonus if turnover < goal
- Salaried pay systems
 - Base salary + bonus (profit, CSI)
 - Base salary + bonus (safety, quality, housekeeping, productivity, # quality team volunteers)
- Service tech bonus
 - Tied to response time and completeness
- Draftsmen awarded bonuses based on drawing grades
- Plant manager perk
 - Plant manager with best annual finished product audit results gets cruise with senior management & top builders

Best Practices: Other Reward Systems (Cont'd)

- Promote from within
- Benefits:
 - Health
 - Vacation
 - Down payment assistance & home purchase programs
 - Kids college tuition



Best Practices: Leadership at Local Plant Level

- Serve as a quality trainer
- Participate in weekly/monthly quality audits of finished product
- Visit set – discuss opportunities with builder
- Participate in customer satisfaction phone surveys
- Participate in customer service follow-up calls



Best Practices: Leadership at Local Plant Level (cont'd)

- Meet with team members regularly & stress quality
 - Weekly plant meeting – with all team members
 - Weekly team luncheon – with 1 department per week
 - Annual “state-of-the-company” event
 - With all team members
 - Celebrate accomplishments & outline objectives for upcoming year
 - Zero defects day celebration – devoted to quality

Best Practices: Leadership at Local Plant Level (cont'd)

- Form a Quality Council and play an active role - Council guides improvement efforts plant-wide
- Organize the business with quality focus:
 - QC Dept. & customer service report to VP Quality
 - VP Quality is preferred career path for GM
- Use the Quality Improvement Process as your primary business management system



Best Practices: Leadership at Corporate Level

- “Quality is a huge deal at Corporate”
- Corporate senior staff meetings
 - Begin with quality measurements - CSI, service response time, service \$, zero defect homes, finished product quality audits, top pareto items, results from improvement teams

Best Practices: Leadership at Corporate Level

- Corporate quality council
 - Plant GMs & QC managers
 - Annual 3 day working meeting at corporate
 - Approach - break into teams, address issues, develop solutions
- Corporate VP of Quality
 - Visits each plant annually
 - Grades plant for its quality processes

Lessons Learned from Quality Leaders

- New philosophy – high quality, continuous improvement & team member empowering pays
- Management's new role - empower people, train, provide resources, develop review systems
- Management at all levels must buy into new philosophy
- Team members must believe management buy-in
- Change will not happen quickly or smoothly – may need to restart