



Factors affecting the Sustainability of the Continuous Improvement (CI) Process

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CI definition

- Approach to quality assurance that involves creating a culture concerned with quality as an integral part of the product/service delivery
- A company-wide process of focused and continuous incremental innovation where small changes with high frequency result in a cumulative positive impact on performance.
- Consistent improvements that increase success and reduce failures
- CI as a culture of sustained improvement which continuously focuses on eliminating waste in all the processes of the organization



CI methodologies

- Lean thinking
 - The elimination of waste
- Six sigma
 - Within Six Sigma, the focus is to produce no more than 3.4 defects for every million of produced units
 - Define, measure, analyze, improve, and control (DMAIC)
- Lean Six Sigma



CI methodologies

- Total Quality Management
 - A concept also is defined mostly as a management philosophy that supports reduction of costs by creating high quality products and services fulfilling customer requirements
- Kaizen
 - Kaizen is the Japanese word for improvement, and it is used to describe a focused and structured improvement project targeting a specific goal, in a specific area, in a short period of time

CI inhibitors

Process issues

- Lack of structure to stop backsliding
- No formal problem-solving process
- Unsuccessful implementation of changes suggested
- Failure to complete projects

Strategy and objectives

- Absence of target and common understanding of direction
- Lack of deployment plan
- Lack of CI strategy
- No long term objectives linked to CI
- No measurable objectives related to CI

Leadership and motivation

- Lack of clear motivation as to why improvement is important
- Inadequate leadership (e.g., no experience, no charismatic leaders)
- Absence of top management support

Cultural issues

- Resistance to change
- Lack of awareness of CI by employees and managers

Measurement and information

- Lack of measurement
- Inadequate information and analysis
- No feedback systems

Training learning and skills

- Lack of learning as a value in the organization
- Lack of training
- Lack of problem solving skills

Others

- Emphasis in disruptive innovation undertaken incremental innovation
- Break of CI teams
- Short resources assigned to CI
- Gap in involving employees at every level



Innovation

- **Product Innovation:** A good or service that is new or has been significantly improved. Significant improvements include technical specifications, components and materials, software, user friendliness, or other functional characteristics.
- **Process Innovation:** A new or significantly improved production or delivery method including relevant changes in techniques, equipment, and/or software.
- **Marketing Innovation:** New marketing methods involving significant changes in product design or packaging, product placement, promotion or pricing.
- **Organizational Innovation:** The introduction of a new organizational method in the business practices of the firm, workplace organization, or external relations.

CI and Innovation

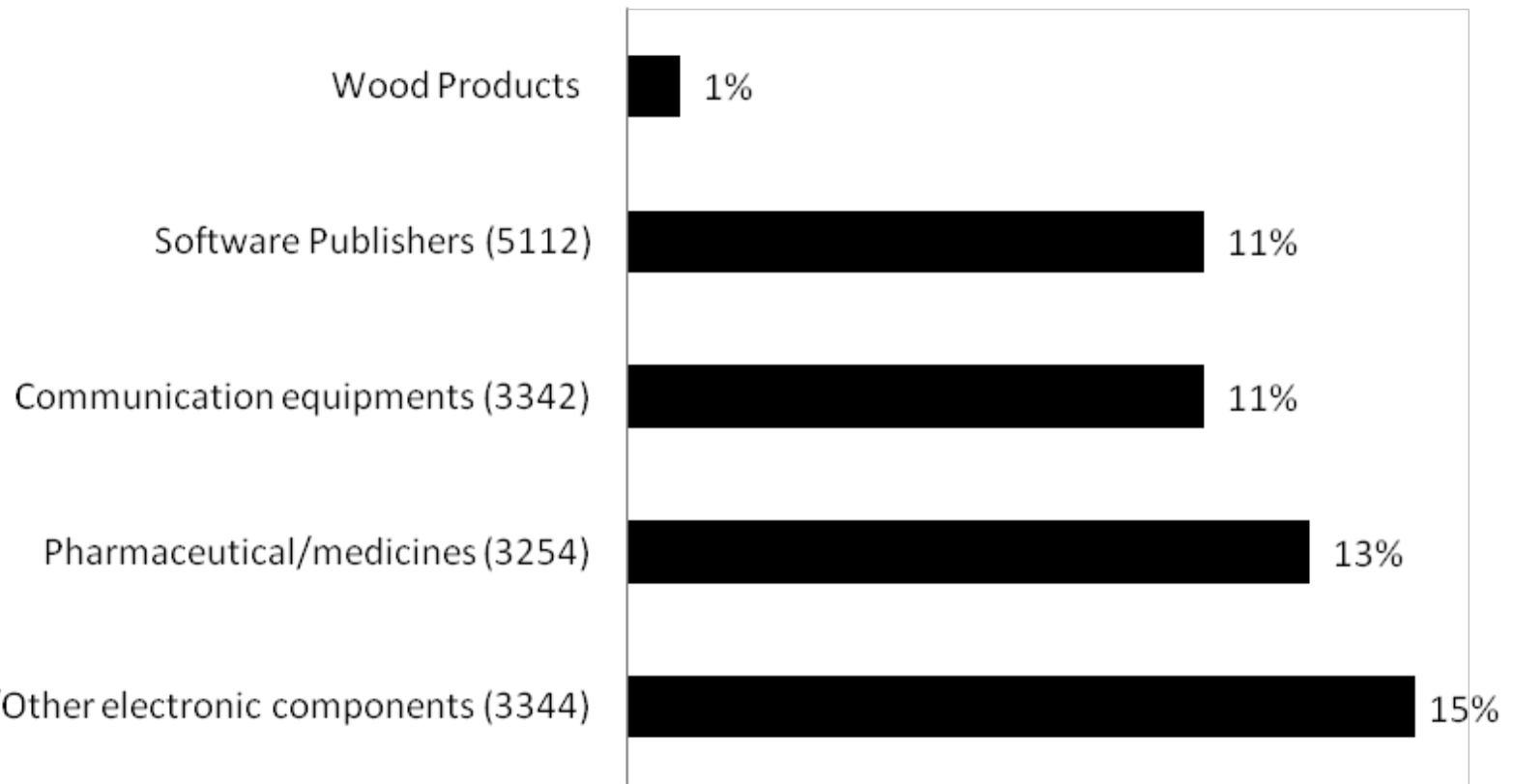
Dimension	Innovation	Continuous Improvement
Timeframe	Continuous and incremental	Intermittent and non-incremental
Change	Abrupt and volatile	Slow and gradual
Scope of the effort	Technological breakthroughs, new inventions, new theories	Conventional know-how
Advantage	Works well in fast-growth economies	Works well in slow-growth economies
Requirements	Large investments	Low investments
Modality of work	Scrap, rebuild or replace	Maintenance and improve



CI and Innovation

- Both approaches search to solve customer needs
- CI improvement can lead to incremental innovation
- Organizational culture oriented to CI contains vital elements to developing an innovative firm.
- The use of problem-solving tools in CI helps to foster creativity and invention, which are elements that develop innovation.
- Firms that perform tasks under CI initiatives also have shown positive performance in innovation.
- A culture of CI within a company acts as a solid foundation on which an innovative culture and organization can be built.
- Training associated with CI resulted in increased employee knowledge of customers, competition, and markets which, in turn, lead to employee-generated innovative product-related ideas.

CI and Innovation



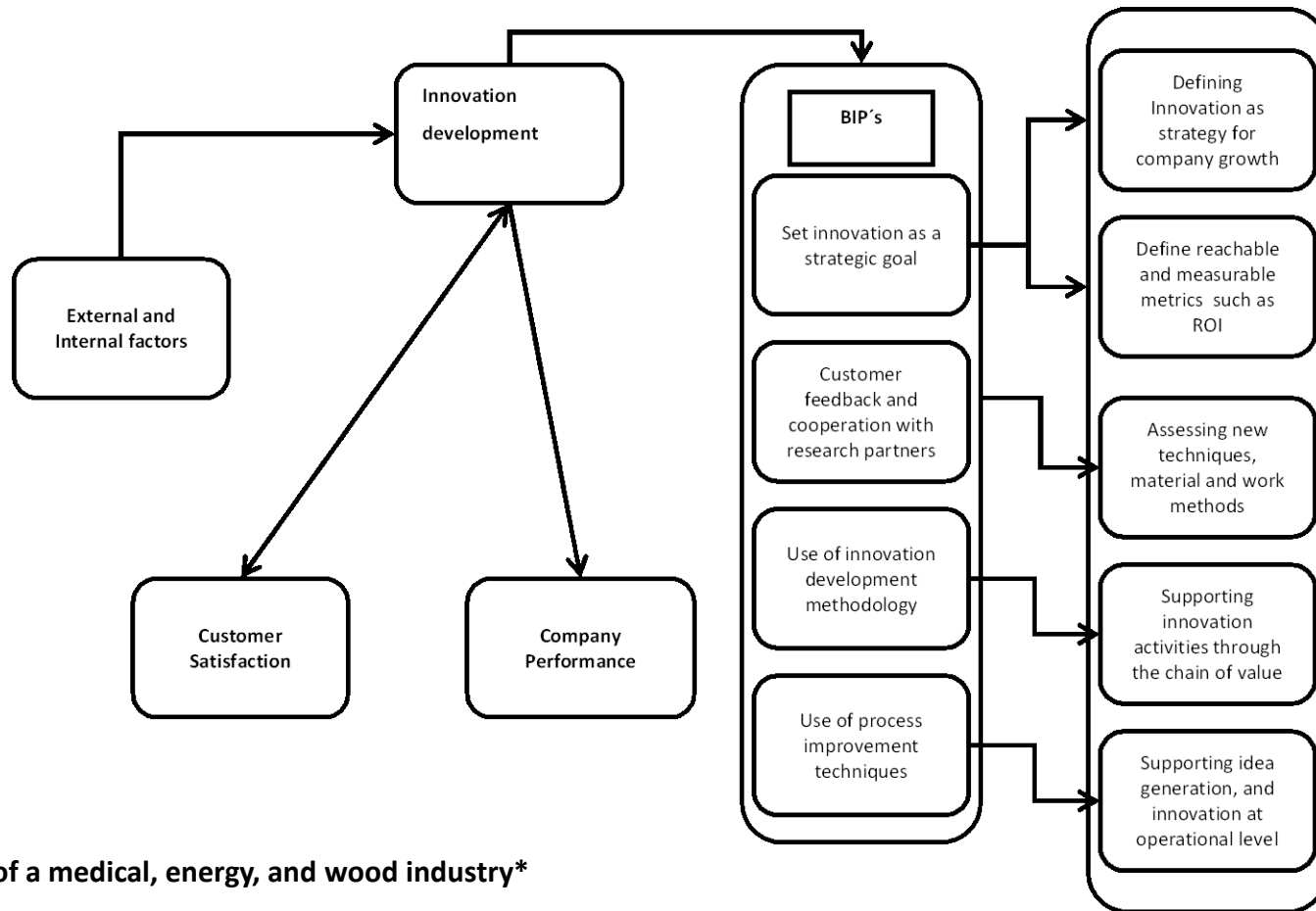
*NFS (2010)



CI and Innovation

- Findings from the literature reveal that:
 - Innovation is strongly related to economic growth
 - ***Wood products*** industry has the ***lowest*** R&D expenditure /sale rate among ***US business sectors***
 - To the knowledge of the authors there are a limited amount of analysis of successful innovation management practices aiming to help the wood products industry to become innovative

Best innovation practices*



2012 Case study of a medical, energy, and wood industry*

Measuring of CI factors

Case Study Methodology

1. Business Sector and Case Selection	2. Research Tool Construction	3. Research Tool Validation	4. Hypothesis Testing	5. Results Analysis
Judgmental selection based on defined criteria	Literature Review Experts' review IRB approval	Cronbach's α CFA EFA	ANOVA Correlation Analysis	Causal Relationship Analysis

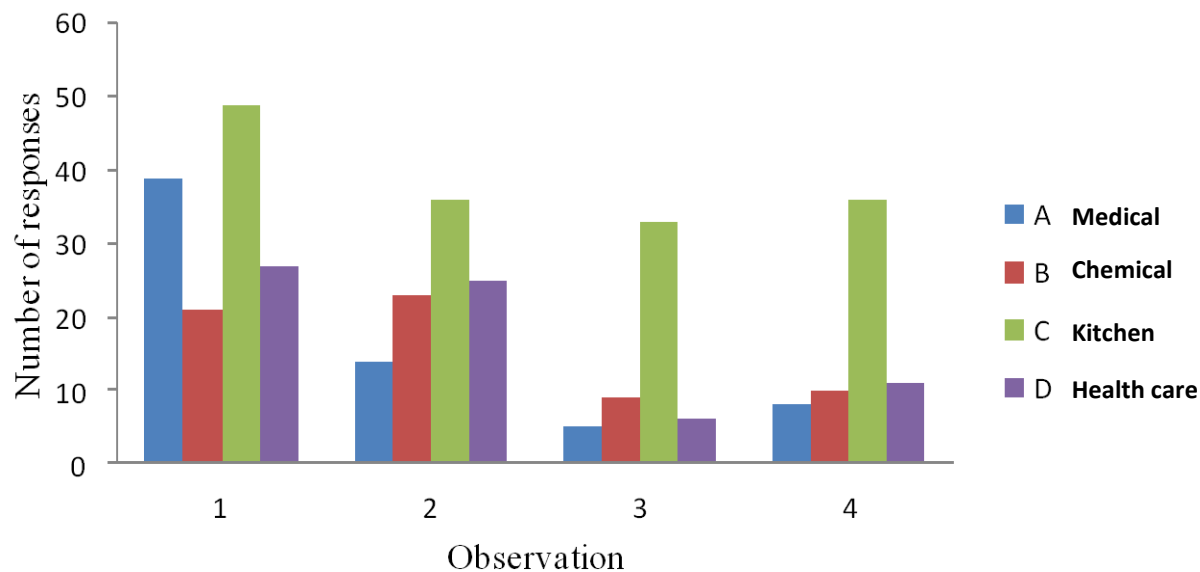
Measuring of CI factors

- Case selection using defined criteria

Criteria	Company A	Company B	Company C	Company D
Activity	Medical Devices Manufacturing	Chemical Manufacturing	Wood Products Manufacturing	Health Care Provider
Location	Heredia, Costa Rica	Cartago, Costa Rica	Virginia, US	Michigan, US
CI process	Over 2 years	Over 8 years	Over 15 years	Over 2 years
Size (selected site)	Over 300 employees	~ 300 employees	380 employees	~ 400 employees

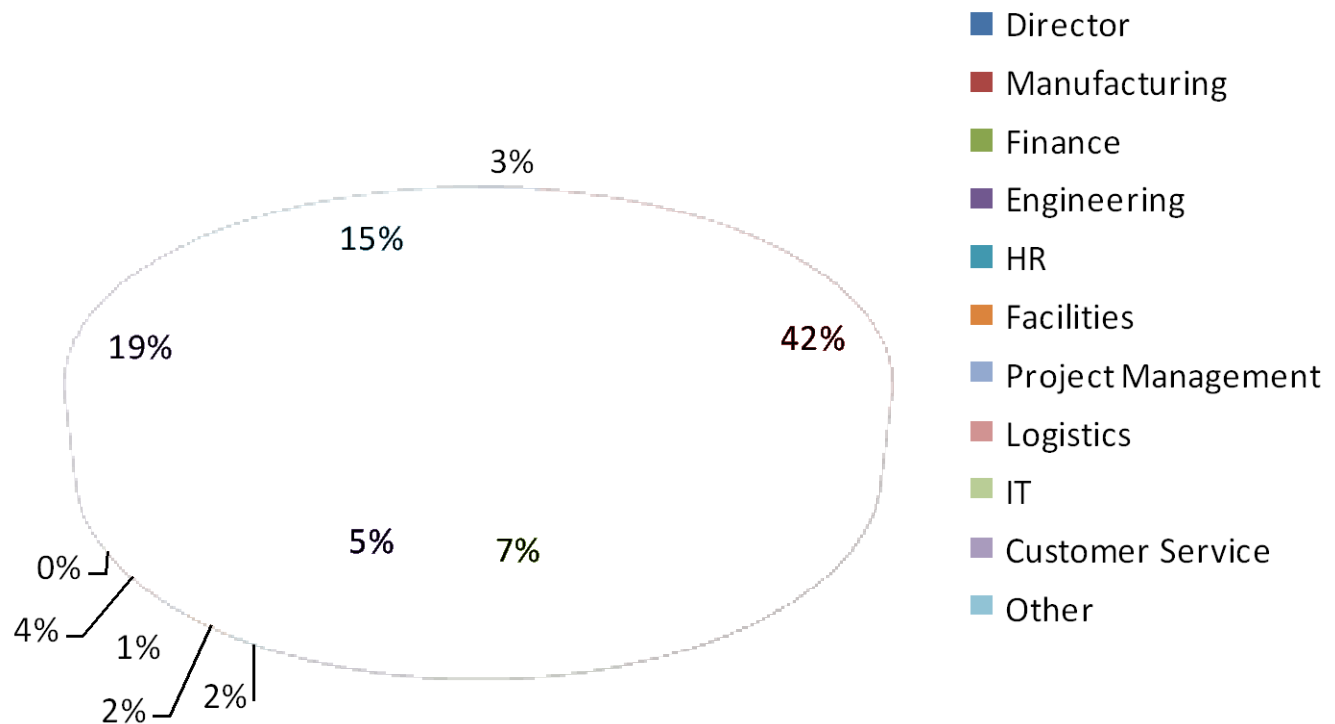
Demographics of responses

- Total of 353 questionnaires, four replicas



Distribution of questionnaires collected per company and observation

Demographics of responses



Percentage of responses per functional area

Data validation

- Questionnaire Validation
 - Internal Reliability of Items
 - Cronbach's α : used to test the extent to which items measure the same construct
 - Cut off value for good internal reliability is ≥ 0.70

Construct	Item	Cronbach's α
Strategic Management	V1 to V12	0.95
Leadership	V13 to V21	0.95
Measurement and Information Deployment	V22 to V31	0.95
Operational Management	V32 to V39	0.95
Training	V40 to V47	0.95
Change Adoption	V48 to V56	0.95
Continuous Improvement Sustainability	V57 to V60	0.96

Data validation

- Confirmatory Factor Analysis (COF) results

Construct	Item	χ^2	RMSEA	CFI
Strategic Management	V1 to V12	<0.0001	0.10	0.91
Leadership	V13 to V21	<0.0001	0.07	0.95
Measurement and Information Deployment	V22 to V31	<0.0001	0.17	0.84
Operational Management	V32 to V39	<0.0001	0.10	0.95
Training	V40 to V47	<0.0001	0.18	0.85
Change Adoption	V48 to V56	<0.0001	0.12	0.94
Continuous Improvement Sustainability	V57 to V60	<0.0001	0.22	0.95

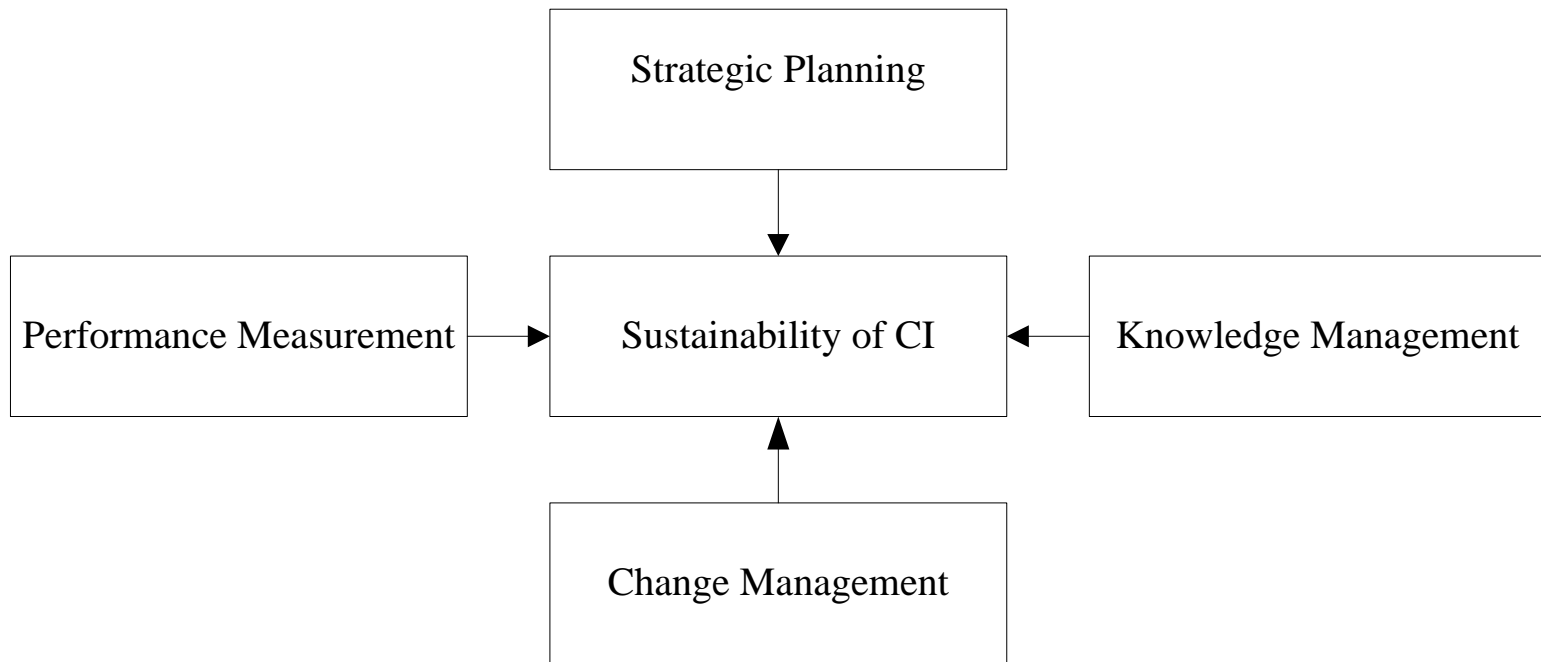
- The proposed model is not a good fit for the data

Data validation

- Exploratory Factor Analysis (EFA): to uncover the structure that best fit the data
 - Fitting procedure used is Maximum Likelihood (ML)
 - Select the number of factors
 - » Kaiser criterion using Eigenvalues of the correlation matrix ≥ 1
 - » Scree plot determines the number of constructs based on the observed elbow of the curve
 - » Accumulated variance (86%)
 - Extract the initial set of factors using maximum likelihood as the extraction method

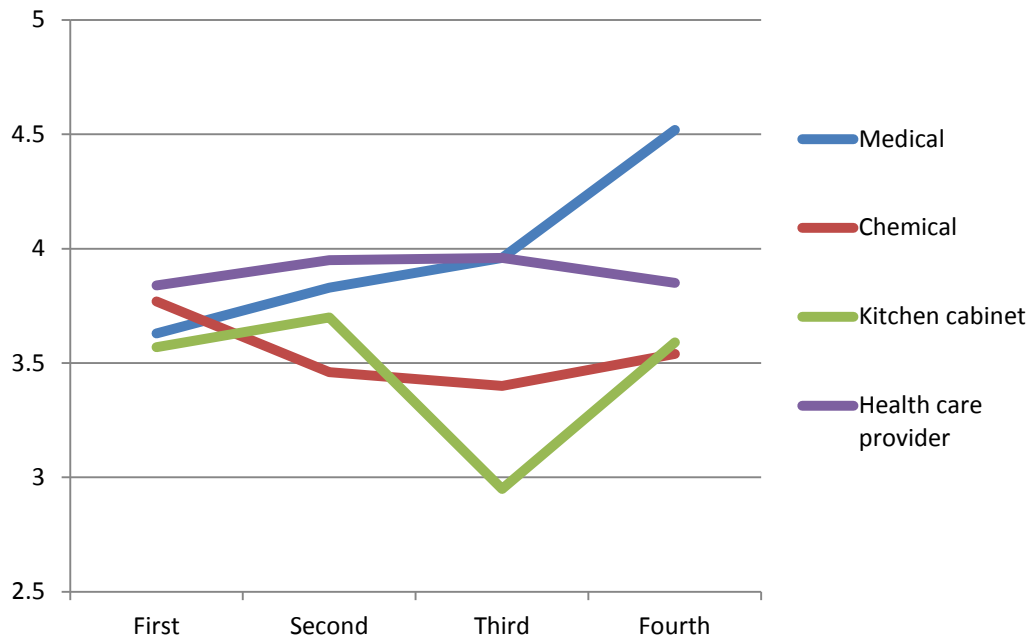
Data validation

- 5 constructs and 50 items were identified



Change Management

- Perceptions



Medical firm: Training CI plan for all associates

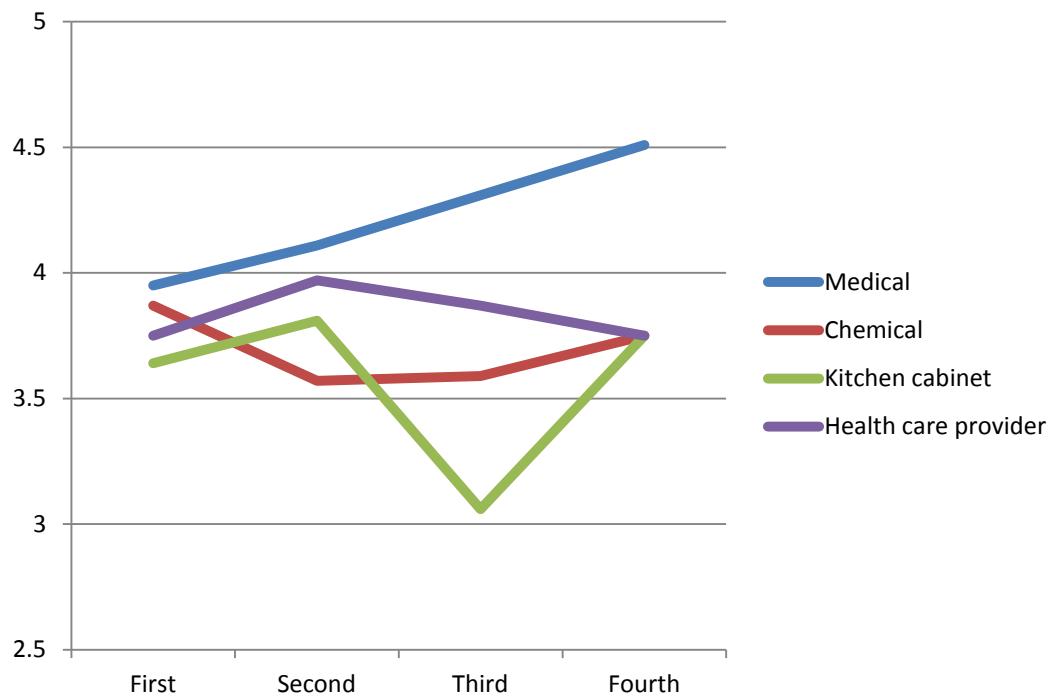
Chemical firm: No differences found

Kitchen cabinet firm: No Kaizen events in third period

Health care provider: No differences found

Strategic Planning

- Perceptions



Medical firm: CI as working policy, including the hiring of a CI leader

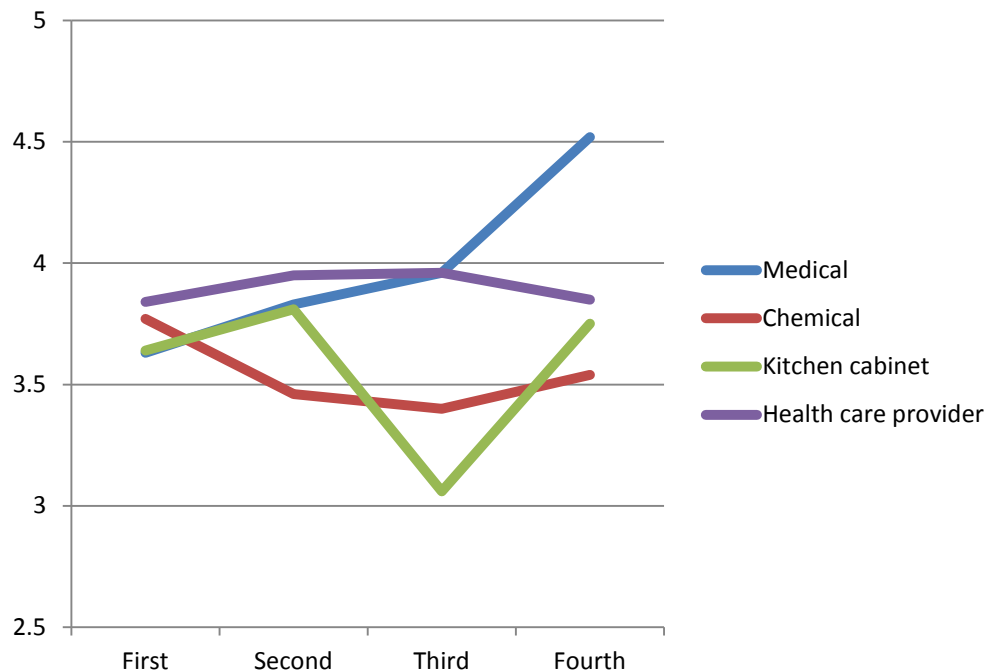
Chemical firm: No differences found

Kitchen cabinet firm: No Kaizen events in third period

Health care provider: No statistical significance

Knowledge Management

- Perceptions



Medical firm: Use of communication tools such as boards

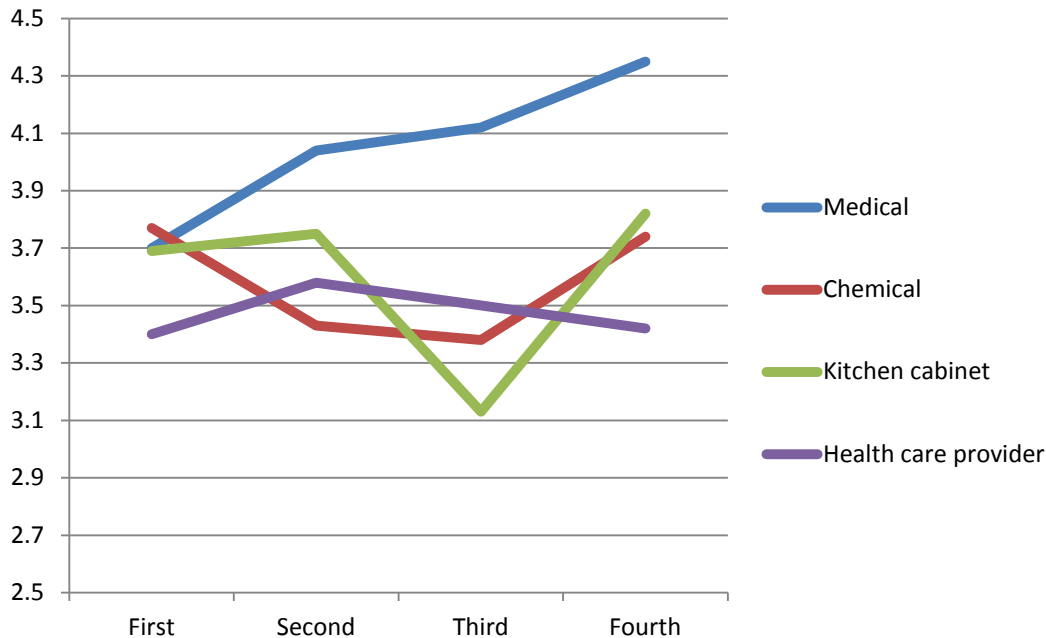
Chemical firm: No differences found. Ability to sustain the CI process

Kitchen cabinet firm: No Kaizen events in third period

Health care provider: No statistical significance

Performance Management

- Perceptions



Medical firm: No significant changes

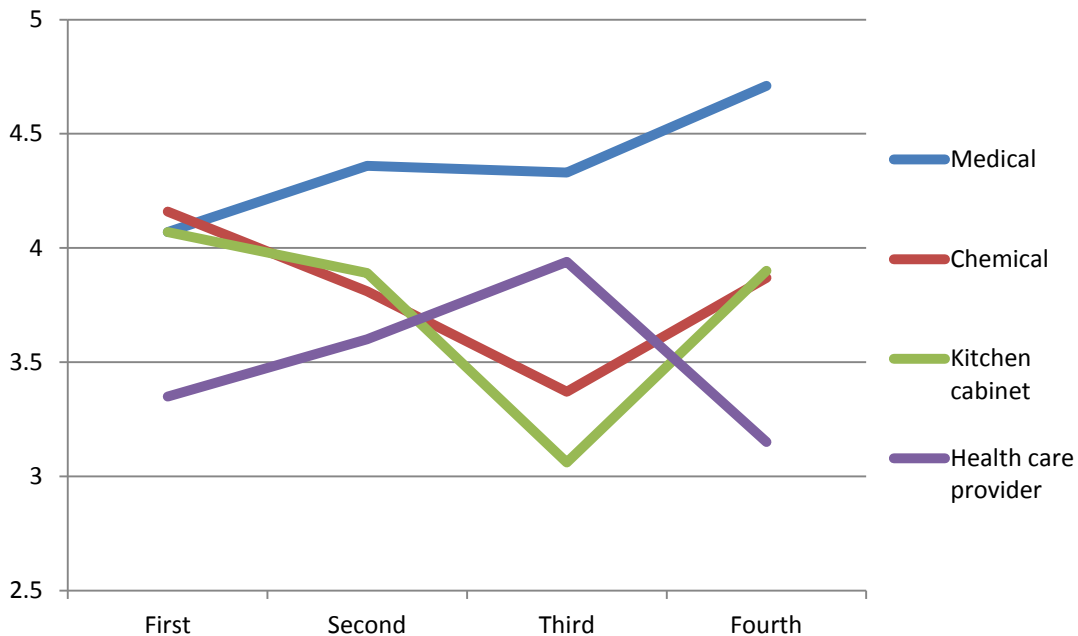
Chemical firm: No differences found.

Kitchen cabinet firm: No Kaizen events in third period

Health care provider: No statistical significance

Sustainability

- Perceptions



Medical firm: No significant over time

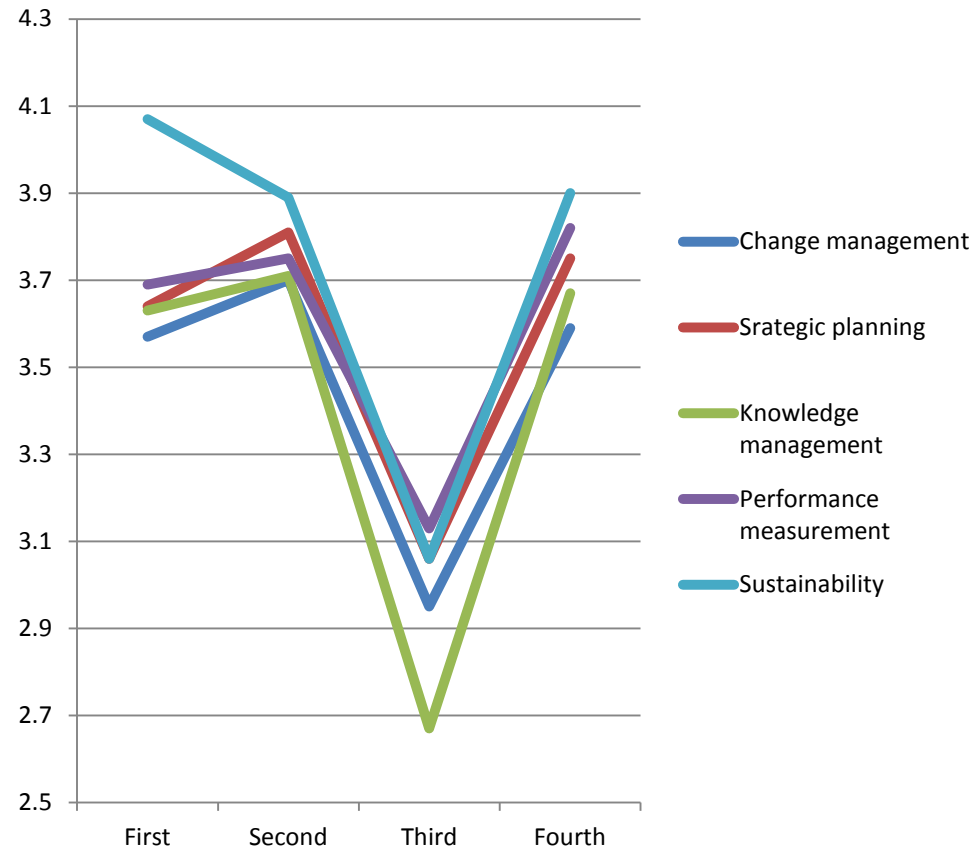
Chemical firm: No differences found.

Kitchen cabinet firm: No Kaizen events in third period

Health care provider: No statistical significance

Kitchen Cabinet

- Third quarter, no Kaizen events because a new manufacturing performance system was being implemented



CI factors correlations

- Strategic planning supports Change Management
- Performance management supports Knowledge Management

Construct	SP	CM	KM	PM	SI
SP (F1)	1.00	0.79 <0.0001	0.79 <0.0001	0.64 <0.0001	0.64 <0.0001
CM (F2)			0.75 <0.0001	0.73 <0.0001	0.65 <0.0001
KM (F3)				0.68 <0.0001	0.59 <0.0001
PM (F4)					0.63 <0.0001
SI (F5)					1.00

To become Innovative....



A path to sustain CI efforts...

CI sustainability framework and management practices

Strategic Planning	Performance Measurement
<ul style="list-style-type: none">• Define CI as a strategic goal• Cascade this goal into departmental and individual goals• Define a CI leader• Set up CI role modeling expectations to managers and supervisors	<ul style="list-style-type: none">• Each goal must be measurable• Use past performance results to set up new metrics• Create metric boards. Make sure everyone sees them• Link performance to rewards
Knowledge management	Change adoption
<ul style="list-style-type: none">• Use IT to spread knowledge• Develop a training plan using success histories• Capitalize knowledge• Develop a certification plan for strategic employees.	<ul style="list-style-type: none">• Use objectives to explain coming changes to reduce change resistance• Reward when change is accomplished• Spread the word about success• Time take to answer questions. Listen to people

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- Thanks!
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