Metrics for Management and VDC Methods to Predict and Manage them

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Metrics Overview

Session	Objectives
Metrics [Lecture/ discussion; Demo; interactive planning session]	Understand and experience: • types of metrics, including project outcome objectives, process performance, and controllable factors • how to track them • methods to use them in management • entering metrics into the POP and associated modeling tools.

Performance Metrics in AEC

The big idea: Progress in AEC effectiveness and efficiency comes from achievement of measurable goals, which include controllable, process and outcome metrics.

You may get what you ask for

Performance Metrics in AEC

"Be careful if you don't know where you're going in life, because you might not get there."

Yogi Berra, 2007, at St. Louis University

Management by Objectives (MBO) requires metrics

- a process of agreeing on objectives within an organization so that management and employees agree to the objectives and understand what they are.
  - The term "management by objectives" was first popularized by Peter Drucker in his 1954 book **The Practice of Management**
  - Source: Wikipedia

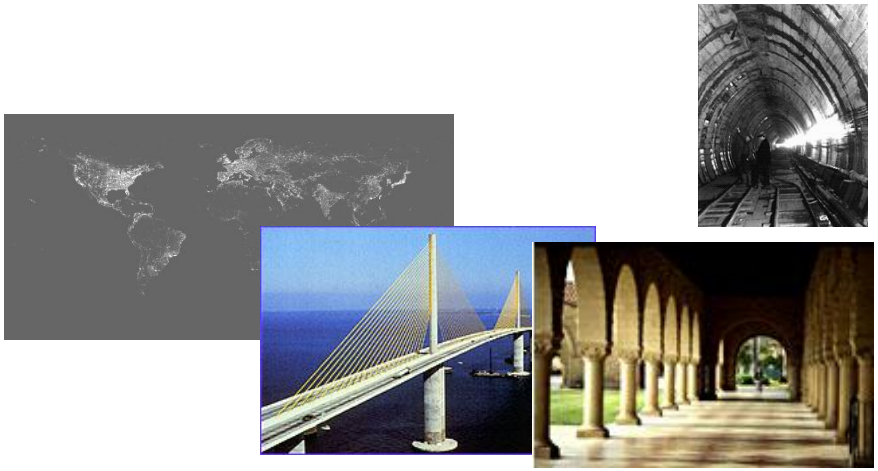
Performance Metrics in AEC

Agenda

- Motivations for metrics
- VDC Objectives
- Methods
- Call to action

Plus-Delta of Civil Engineering

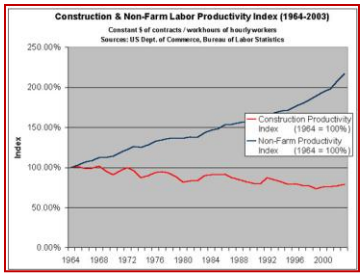
- Provides fixed physical assets and wealth
- High global demand for infrastructure and housing
- Opportunity to impact global climate challenge significantly



Plus-Delta of Civil Engineering

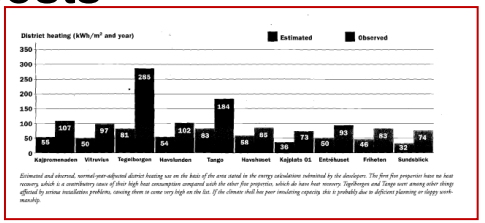
- Provides fixed physical assets and wealth
- High global demand for infrastructure and housing
- Opportunity to impact global climate challenge significantly

- Low productivity → compete with other ways to spend $



US Department of Commerce, compiled by P. Teicholz

- High energy use and rising energy costs



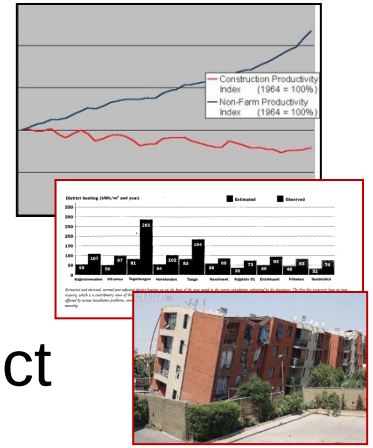
Persson, *Sustainable City of Tomorrow: B01—Experiences of a Swedish Housing exposition*

- Structural reliability << societal need (Chile)

Guilllermo Gomez, PUChile

Issue: How to respond to the issues of productivity, energy, structural reliability?

- Incremental improvement ← incremental change
  - Decades of evidence
- Breakthrough improvement ← significant change
  - Business objective: *Significantly* improve project delivery performance for the client
  - To achieve breakthrough: select & align *Outcome, Process and controllable performance metrics*



A manager can do only a few things ….

Opportunity

- Owner: increase value of facility investment
- Contractors: increase efficiency and profit

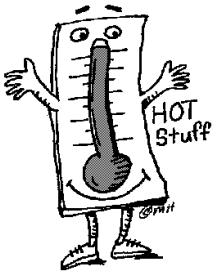
Method: set objectives; provide resources and methods

- Controllable factors
- Process performance
- Project outcome

Objectives: theoretical framework

- Control (Management):
  - What we want; what we can control
  - e.g., P, O, P functions, scope, behaviors to measure and manage

→Process



  - What we measure day by day, week by week
  - Basis on which we manage and intervene
  - e.g., Design, schedule & cost conformance

→ Outcome

  - What we report to client, senior management
  - e.g., project safety, schedule, cost, quality

Objectives: theoretical framework

Goals: purpose Example: Aesthetically pleasing	Objectives: target Example: Schedule conformance >= 80%
intangible	tangible: “touch” them
abstract	concrete
cannot be validated	can be validated
general	precise
broad	marrow
relate to outcome	relate to outcome

Public metrics in AEC practice

Mace retrofit project at Heathrow

Obayashi construction, Tokyo

Schuff Steel Plant, Phoenix, AZ

Sutter Health, CA

Virtual Design and Construction (VDC)

Use of multi-disciplinary performance models of design-construction projects, including

- *Product* (i.e., facilities)
- *Organization* of the design-construction-operation team
- *Work Processes*
- *Economic Impact* (i.e., model of both cost and value of capital investments)

to support (explicit, public) business objectives.

Practice → Breakthrough Performance

	Practice: 2002	Objective: 2015
Schedule	1-6 y Design ~1.5 y Construct Variance 5-100%	1 y Design < .5 y Construct Variance < 5%
Cost	Variance 5-30%	Variance < 5%
Delivered quality	Large Variance Good? Productivity impact?	0 variance, by POE Great, by POE ++ productivity
Safety	Good	Better
Sustainability	Poor	25% better than 2002
Globalization	Some	>= 50% of supply and sales

Design-Construction Practice → Controllable Objectives for CIFE Member Companies

2002

- ✓ Operate with a *strategic plan* to implement VDC incrementally
- ✓ Use (Visualization) stage of VDC confidently
- • *Staff* each project with four VDC trained engineers

2011

- • Operate with a *strategic plan* for VDC; manage by public and explicit M-B process metrics
- • Use (Integration) *(>= 5 business purposes* on *>=10 major projects/yea*r)
- • Pilot (Automation); *automate >30% of routine design and construction activity (> 2 pilot projects/year); and*
- • *Staff* each project with *four VDC trained engineers*

(Multiple) *Controllable factors*

- **VDC strategy and plan** ***Control***
  - **P, O, P elements to design, visualize and track**; to **integrate**; to design **automatically or prefabricate**
  - **Model and manage** 100% of POP items with > 10 (1)% of time, cost, effort or energy
- **Target design objectives:** Set by target design process
- **VDC scope:** P, O, P elements to model and analyze; to integrate; to design automatically or prefabricate, to schedule and track
  - **Model and manage** 100% of POP items with > 10 (1)% of time, cost, effort or energy
  - **Maturity phase:** Visualization, Integration, Automation
- **Number of trained VDC engineers:** 4/project
- **Public process performance metrics:** Weekly report safety + ~5 process performance metrics

Project goals that can vary by project

(Multiple) *Controllable* objectives

- **Stakeholder engagement:** public and explicit definition of who, when, for what purpose
- **Coordination activities (requests + responses)**
  - 90% of all coordination activity planned (weekly), explicit, planned and publicly reported
  - 90% of all planned coordination activity is reported (weekly) by intended recipients to have been timely and suitable
- **Prediction basis:** > 80% of all predictions by founded, automated methods
- **Design versions**: 2 or more >= 80% of all decisions that affect more than 10% (2%) of cost, effort or schedule
- **Globalization strategy and plan:** >= 50% of components and services from global suppliers
- **Lifecycle cost factors considered**: money; natural resources consumed; emissions

Use controllable factors …

- Whatever your role: A, E, C or O
- Collaborating with your other stakeholders
- *At least every two weeks*
- Identity factors *you* can and want to control for your
  - Overall project
  - Next project phase
  - Next 2 weeks

Controllable Factors

- **VDC Strategy:** POP elements to design, integrate, automate
- **VDC Scope**: models to make and LOD
- **Coordination activity** to plan, track, review and manage
- **Number of trained VDC engineers**
- **Public process performance metrics to track**
- **Design versions**
- **Focus of attention** of available staff

Controllable factors include: *VDC implementation tasks*

Tasks: Choose

- Models to build, analyses to make
- Modeling, analysis, data management tools
  - Software
  - Hardware
  - Data storage and network data sharing
  - Display
- Meeting space:
  - Room size(s) and location(s)
  - Technology, e.g., SmartBoards, white boards, tables, chairs, …

Controllable factors include:
Operating agreements for VDC meetings

- intended meeting participation
- expected preparation of participants
- duration
- frequency
- agenda management strategy
- review process to check quality, cost and schedule conformance
- expected use of models, analyses, metrics

Controllable factors include: *methods to use metrics data*

- Collect performance data: existing reporting systems (e.g., cost), data-acquisition systems (e.g., energy) on-line surveys (e.g., quality conformance), post-it notes (e.g., latency), …
- Display: bar charts; spider diagrams; time plots
  - Include measured data, objective (range), traffic light status
- Report: on the wall; meetings; web …
- Interpret: responsible party, selected groups

Controllable factors include:
methods, tools, and modeling, processes to implement

- Methods: specific kinds of models, analyses and metrics
- Tools: specific 3D, 4D, organization, scheduling, product modeling and analysis tools
- Processes: modeling, data exchange, data collection, reporting, management
  - Assessment methods: public display adds many eyes; ICE sessions discuss and address
  - Interventions when metrics suggest a problem:
    - Root cause analysis
    - Small or large ICE session to plan interventions

Controllable factors include: *methods to use metrics data*

- Collect performance data: existing reporting systems (e.g., cost), data-acquisition systems (e.g., energy) on-line surveys (e.g., quality conformance), post-it notes (e.g., latency), …

Controllable factors in project execution for *your* project template in POP model

Controllable project execution factor	Responsible Stakeholder	Enabling resources/ tasks

VDC impacts traditional management practices

Changes	Issues
Management risk identification and attention allocation become model-based	Physical and social environment that fosters multi-stakeholder interaction → Use iRooms for design and construction management*!*
Stakeholders need a shared vocabulary and methods	Believability, timeliness of project definition → Build POP models early and often*!*
Stakeholders need skill to make, analyze and engage with models	Train; give slack to learn → Consider Certificate Program
VDC becomes a new process to manage	Stakeholder(s) to model and analyze → Adapt organization and process*!*

Method to Manage Using VDC in Practice

Method: objectives

- *Controllable* factors: choose them*!*

⇒ *Process* performance: measured ~ daily, weekly

  - Safety
  - Schedule, cost, quality conformance
  - Response, decision latency
  - Risk
  - Field RFIs
  - Rework volume
  - Field material delivery

⇒ *Project* outcome: seek breakthrough

(Multiple) Measurable *Process* objectives

- **Safety: 0 lost-work incidents**
- **Conformance to schedule (PPC), cost, quality, target value, delivery & stakeholder participation objectives:** [>=90 - 99% within 2% of plan]
  - Schedule conformance = "percent of promises/plan complete" (PPC)
  - Stakeholder participation: reported meaningful and timely participation of intended stakeholders in design/construction reviews
- **Latency**
  - Response (decision-making no earlier than necessary): [minutes in design sessions; mean <= 1 working days; 95% < 2 days]
  - Decision (decision-making promptness): [minutes in design sessions; mean <= 1 working days; 95% < 2 days]

Project objectives that can vary by project

(Multiple) Measurable *Process* objectives

- **Risk:** 100% concurrence by all intended review stakeholders that sub-tasks were completed per specification for *all* tasks that affect life or corporate safety
- **Field performance:**
  - **Material delivery:** 98% within 24 hours of use
  - **Field-generated Requests for Information**: 0 (for questions related to issues that could have been identified at the award of the construction contract)
  - **Rework volume**: 0
- **Timely, meaningful and relevant meeting participation:** 90% as reported by all intended stakeholders

Project objectives that can vary by project

Use process metrics …

- Whatever your role: A, E, C or O
- Collaborating with your other stakeholders
- Daily or weekly,
  - measure process performance
  - compare predicted and measured process metric values with objectives
- Based on variances, update product, organization and process scope to improve performance

Process

- **Safety**
- **Conformance** to schedule (PPC), cost, quality, delivery, stakeholder participation objectives
- **Latency (promptness)**
- **Risk**
- **Field** material delivery, Requests for Information, rework
- **Meeting participation**

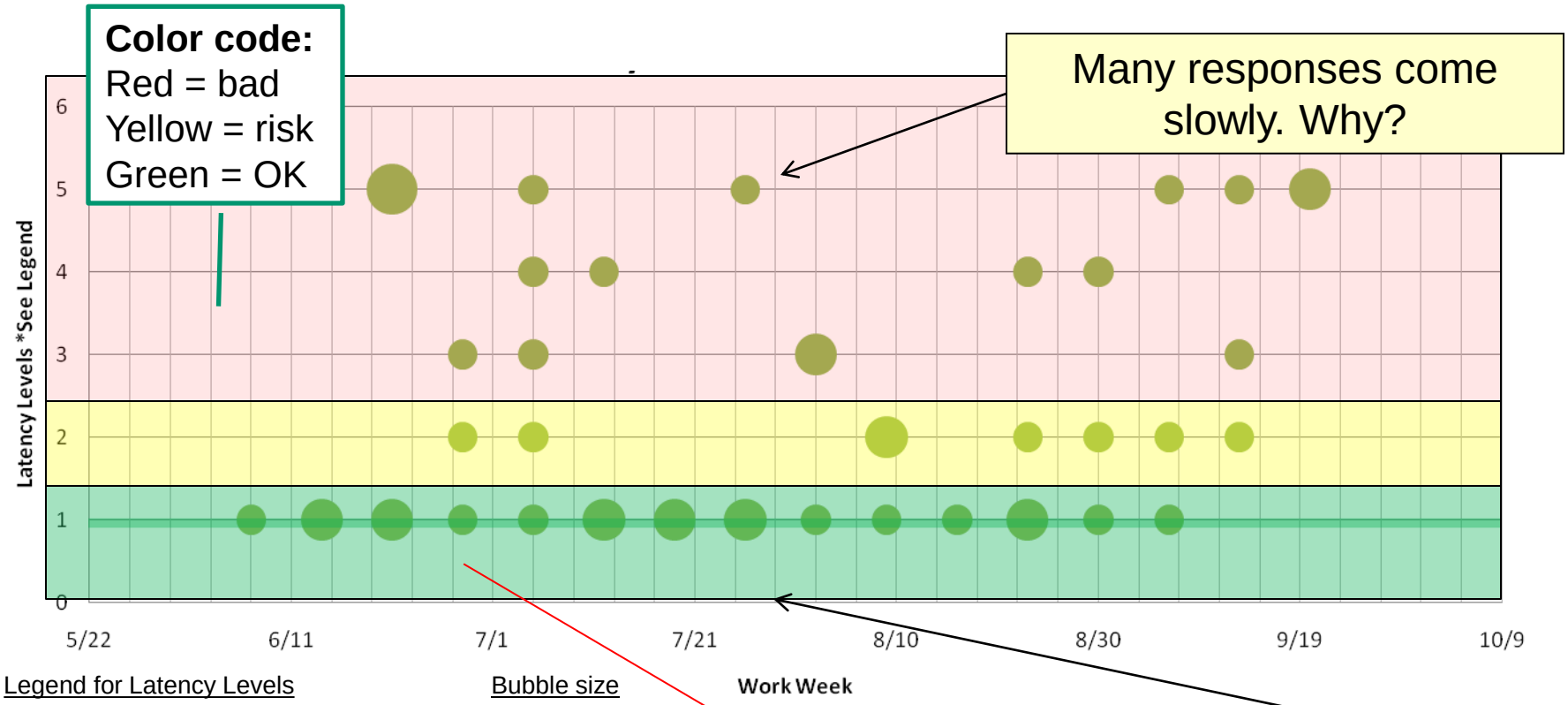
One company - current practice on metrics
Note that most serve reporting, not management

NAME	TYPE	UNITS	COLLECTION	WHO MEASURES	ROLE
cost - hours spent per "activity"/ "project"	P	hours	daily	accounting	overhead tracking
schedule - Planned percent complete	P	%	weekly	project team weekly, senior mgt monthly	
cost - design fee	P		weekly		
Cost - Budget compliance	P	man hours/$ ($ or % deviation?)	bi-weekly, PBA	PM	profitability measure
schedule - variance report	P	Days/time	monthly or bi-monthly	project manager/ business unit leader	confirms schedule conformance
schedule - conformance	P	dates, man hours	bi-weekly	PM, deputy PM	track design progress

Metrics matrix for one project
Note that most serve reporting, not management

Control specification/ Conformance:	Communication Behavior:	Schedule:	Cost:	Quality:
Model product, process breakdown structures, LOD and scope	Meeting Effectiveness	Latency	Detailed Cost Conformance	Field-Generated RFIs
VDC/Lean process steps	Visualization use	Conformance (PPC)	Cost: Rework Volume	Client Satisfaction
Commitment schedule level of detail	Field Interest in model or metrics content	Field Material Delivery		Safety performance
		Vico performance		Alignment of organization incentives and interests

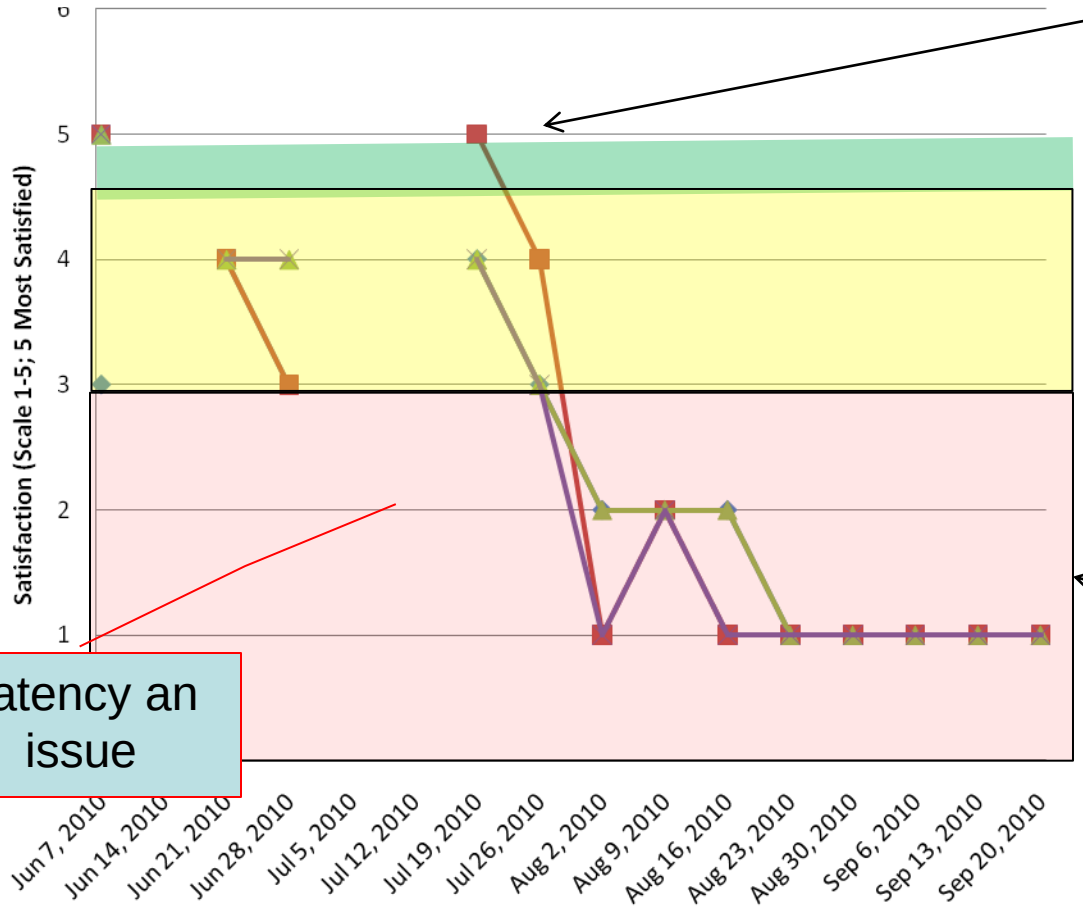
Stakeholder latency over time for most critical issue of the week:
Data suggest some stakeholders do not respond promptly



Client satisfaction over time:

Data suggest client concern over GC performance

Some survey results indicate satisfaction



Objective: 4-5

Latency an issue

Client clearly developed an issue. Caused by emergence of latency as an issue?

Process performance assessment for *your* project

Process performance goal	Typical performance today	Your project objective
Field safety		
Schedule conformance (%)		
Cost conformance (%)		
Quality conformance (%)		
Latency (days)		
Timely & meaningful meeting participation (%)		
Risk		
Other		

(Multiple) Project *Outcome* objectives

- Safety: 0 lost hours
- Schedule:
  - Design within **1 year** (SD, DD, CD), (90% conformance)
  - Construct within **6 months** (95% conformance)
- Cost: within 2% of budget (95% conformance)
- Quality: 100% satisfaction by POE
- Sustainability: 20% better than previous recent jobs
- Delivered Scope: 100% satisfaction by POE assessment (all jobs)
- Globalization: >= 50% of supply chain from global suppliers

Project goals that can vary by project

Outcome performance assessment for *your* project

Outcome performance goal	Typical performance today	Your project objective
Field safety		
Schedule		
Cost		
Quality		
Risk		
Energy		
Other		

VDC impacts traditional management practices

Changes	Issues
Model-based predictions become relevant, believable and inexpensive deliverables	Model and model-based analysis timeliness and believability → Deliver at least weekly*!*
Daily/weekly performance measurement becomes a new process to manage	Culture that welcomes (or tolerates) "failure" reports → Make performance public and explicit*!*
Stakeholder interactions reference VDC models	Model Level of Detail (LOD) →Work carefully to build, integrate and manage multi-discipline models*!* →Use separated but consistent models →Help project use corporate methods*!*

Use outcome performance …

- Whatever your role: A, E, C or O
- Collaborating with your other stakeholders
- At every major milestone
- Compare measured outcome values with objectives
- Based on variances, update
  - objectives for controllable factors
  - process and outcome objectives

Outcomes

- **Safety**
- **Schedule**
- **Cost**
- **Delivered Scope**
- **Sustainability**
- **Globalization**

VDC impacts traditional management practices

Changes	Issues
Ability to model and make model-based analyses becomes requirements for success	Ability to put VDC competence on all projects → Support professional development of staff and stakeholder partners
Responsibility for success and failure become public, often early	Early visibility of risks requires flexible management and resources to mitigate them → Consider consulting "swat teams"*!*
Cross-project improvement in modeling and analysis methods becomes a crucial business competence	Corporate focus required to integrate models, automate processes, help as needed → Empower a CIO team*!*

(Multiple) Predictable performance objectives:
*Changed in 2011

Controllable	*Process [Conformance to plans]*	*Outcome [Performance]*
Product, organization, process designs	**Latency:** mean <= 1; 95% within 2 working days	**Safety:** 0 lost hours
Coordination activity: planned, explicit, public, informed > 90%	**Field-generated Requests for Information**: 0	**Schedule**: 95% on-time performance
Facility managed Scope: 100% of items with > 2% of value, time, cost or energy	**Rework volume**: 0 (for field construction work); objective = 10-20% (virtual work)	**Cost**: >= 95% of budgeted items within 2% of budgeted cost
Prediction basis: > 80% of predictions founded	***Product/Organization/Process Function (quality) conformance (%):** >= 99%	**Delivered Scope**: 100% satisfaction
Design versions: 2 or more >= 80%	**Schedule conformance (%):** >= 80%	***Sustainability: >**75% better energy, water, materials, than 2002, profitably
Staff trained in VDC: >= 4/project	**Cost conformance (%):** >= 95%	

(Multiple) Predictable performance objectives:

We recommend project collect all process metrics

Controllable	*Process [Conformance to plans]*	*Outcome [Performance]*
Product, organization, process designs	**Organization Latency:** mean <= 1; 95% within 2 working days	**Safety:** 0 lost hours
Coordination activity: planned, explicit, public, informed > 90%	**Process Field-generated Requests for Information**: 0	**Schedule**: 95% on-time performance
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Prediction basis: > 80% of predictions founded	**Product/Organization/Process Function (quality) conformance (%):** >= 99%	**Delivered Scope**: 100% satisfaction
Design versions: 2 or more >= 80%	**Process Schedule conformance (%):** >= 80%	***Sustainability: >**75% better energy, water, materials, than 2002, profitably
Staff trained in VDC: >= 4/project	**Product/Organization Cost conformance (%):** >= 95%	

VDC models support metrics

- Models support process and outcome performance:
  - Product
  - Organization
  - Process

Process	*Outcome*
Safety	**Safety**
Conformance of schedule, cost, quality, delivery, stakeholder participation to objectives	**Schedule**
Latency (promptness)	**Cost**
Field-generated Requests for Information	**Delivered Scope**
Rework volume	**Sustainability**
Timely & meaningful meeting participation	**Globalization**

VDC models support metrics

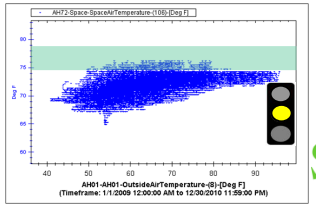
Product, organization, process analyses support process and outcome performance:

- **Product**
  - Costs
  - Daylight
  - Energy
  - Interferences (3/4D)
  - Quantities
  - Rentable space
  - Structure
- **Organization**
  - Backlog
  - Commitments
- **Process**
  - Risk
  - Schedule, cost, quality
  - Meeting participation

Process	*Outcome*
Safety	**Safety**
Conformance of schedule, cost, quality, delivery, stakeholder participation to objectives	**Schedule**
Latency (promptness)	**Cost**
Field-generated Requests for Information	**Delivered Scope**
Rework volume	**Sustainability**
Timely & meaningful meeting participation	**Globalization**

Suggestions on process metrics

- Use conformance to keep number of metrics small, e.g.,
  - **Quality:** 100% Conformance of designed spaces to stated architectural functional objectives
  - **Schedule:** 90% of tasks start and finish within 1 day of operating schedule
  - **Cost:** 98% of budgeted items have actual cost within 2% of estimates
  - **Stakeholder participation:** 98% of all intended stakeholders report timely and meaningful participation in meetings
- Track performance → Root cause problems → reduce variance → improve mean
- Show performance and objective on graphs w/assessment



Conformance failure … a true story

There is a conflict in the Construction Documents as to the extent of demolition of Building 122 between the architectural drawings and the structural drawings.

The structural drawings indicate the Second Floor is to be protected in place to serve as a roof for the walkway coming in from Building 165C.

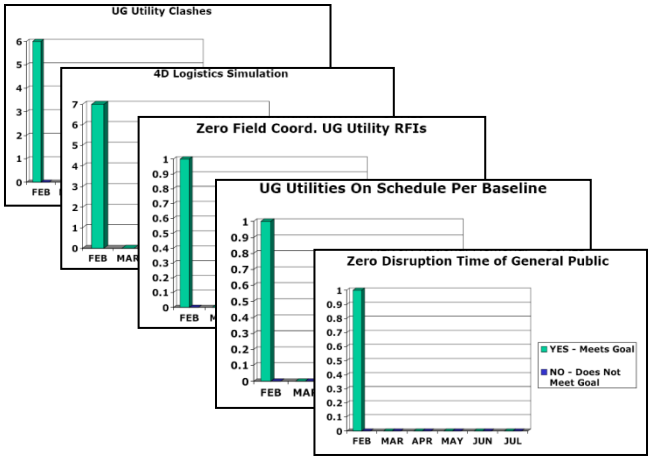
The architectural plans indicate that demolition is to be done down to the First Level.

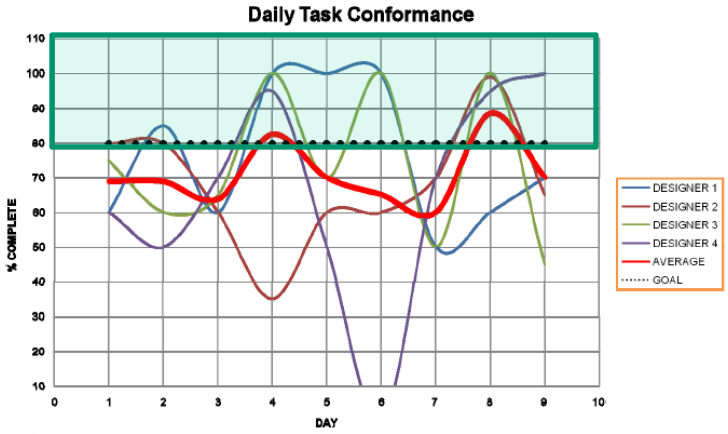
Rather than send an RFI to resolve the conflict, the contractor went ahead and demolished the building down to the First Level.

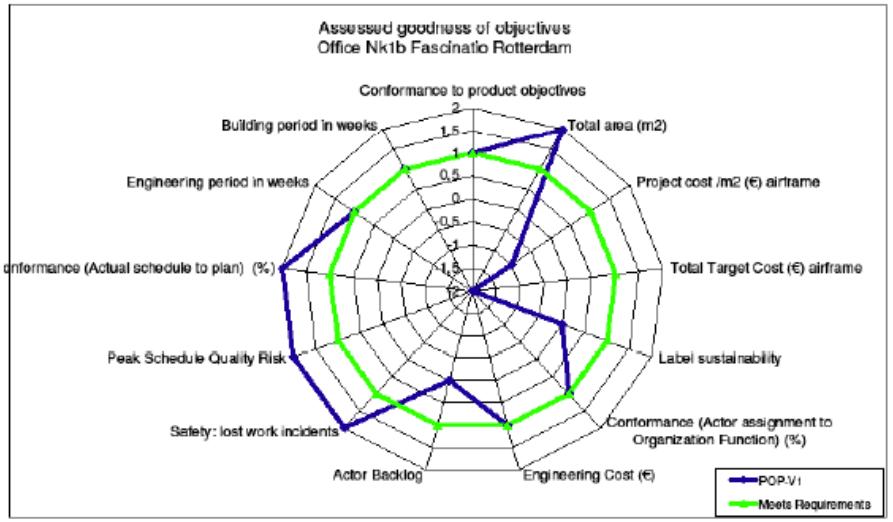
Now, the design team is required rebuild the Second Level.

Suggestions on process and outcome metrics

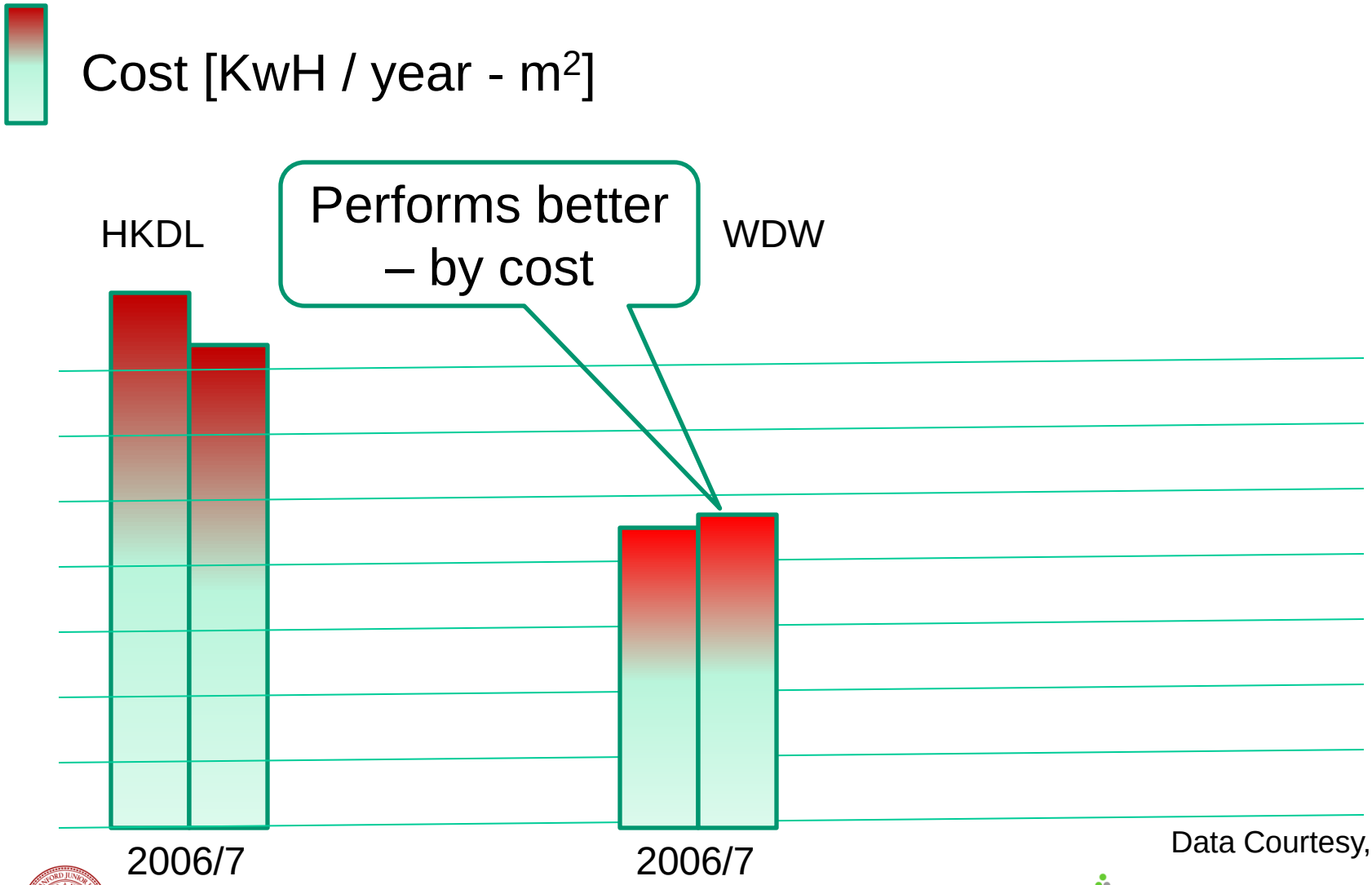
- Public & explicit
- Display objective & data graphically
- Show performance over time
- Show multiple relevant metrics
- Display and discuss at least weekly







Suggestion - choose units carefully: cost vs. list-cycle cost vs. value



Data Courtesy, WDI

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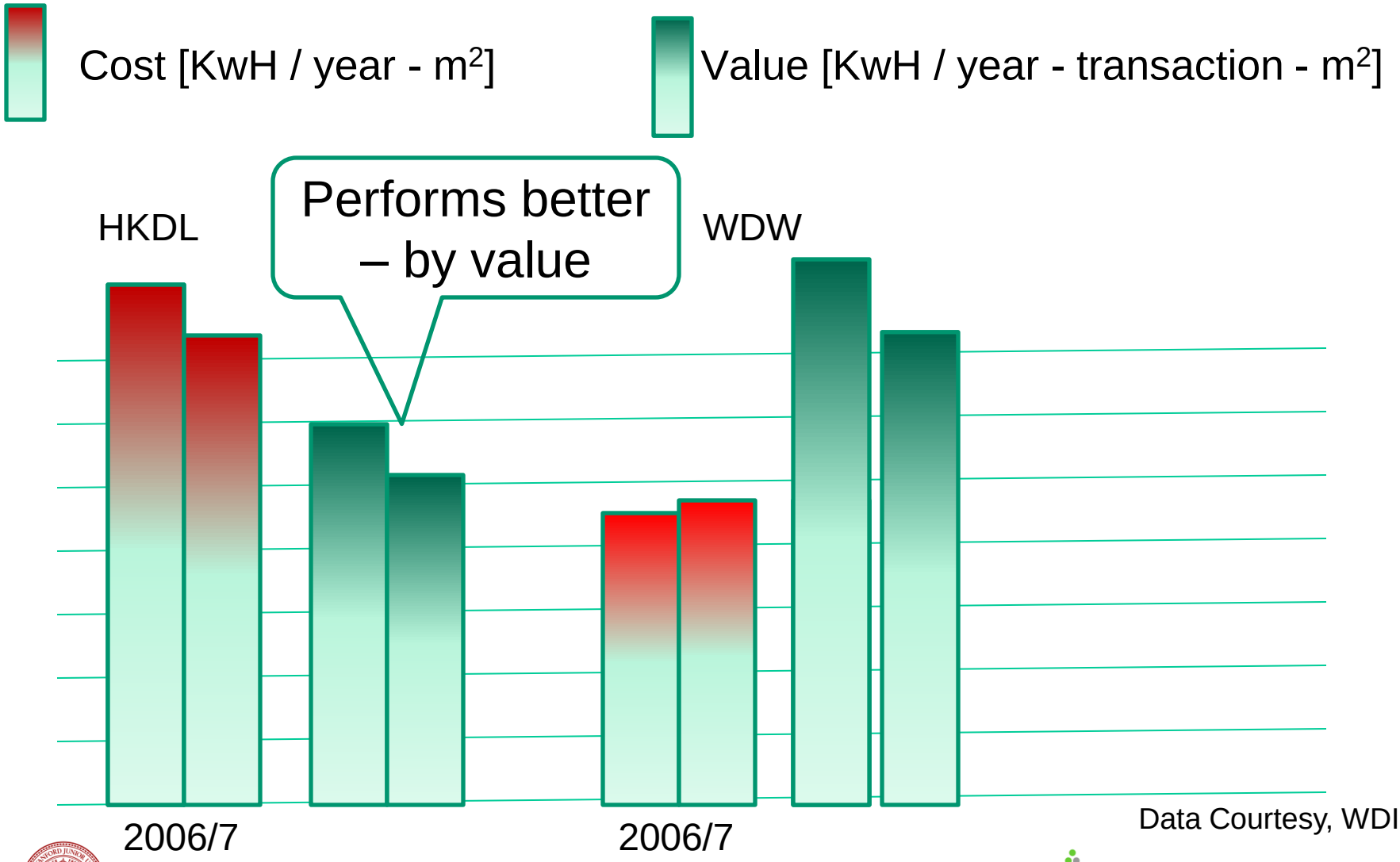
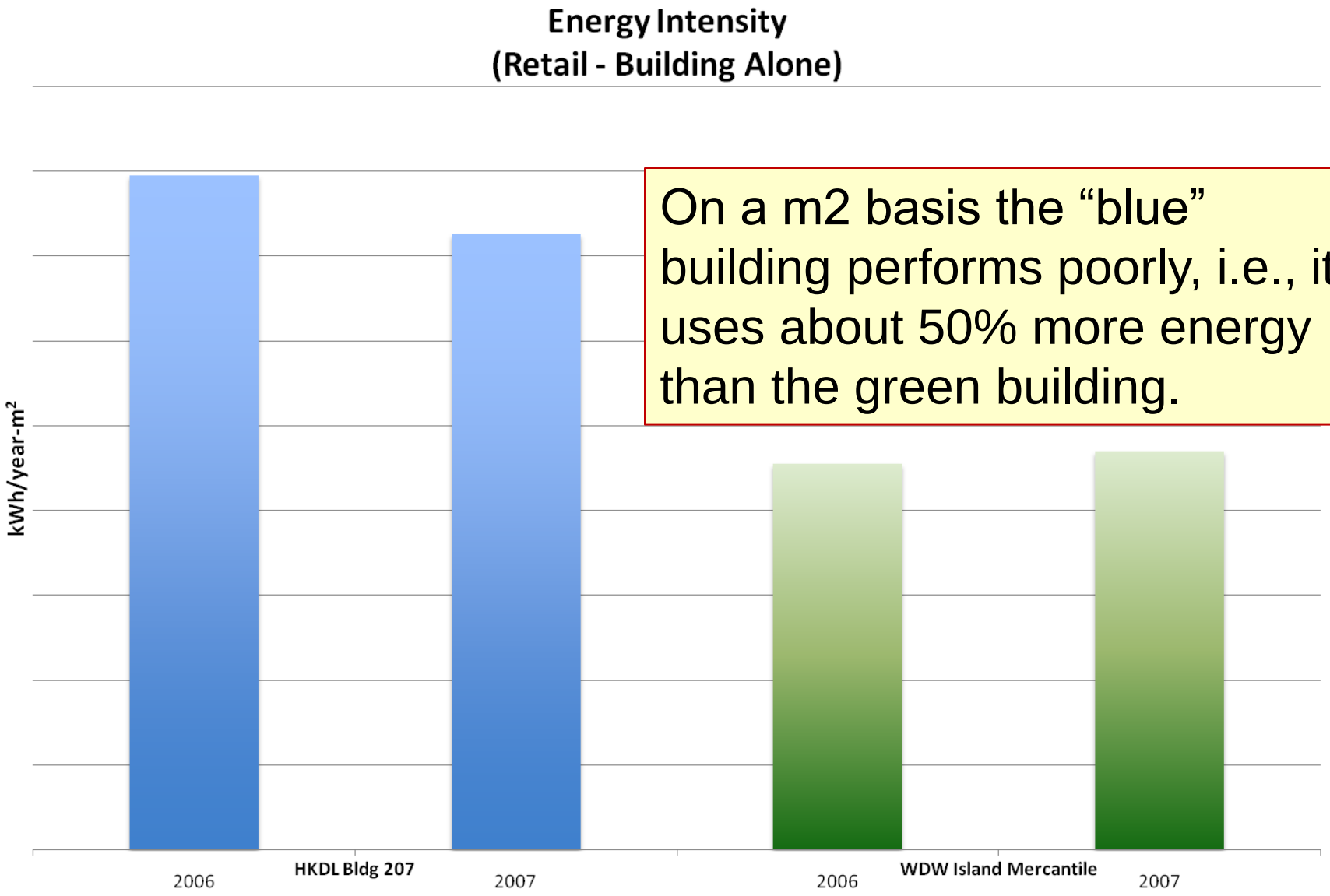


Data Courtesy, WDI

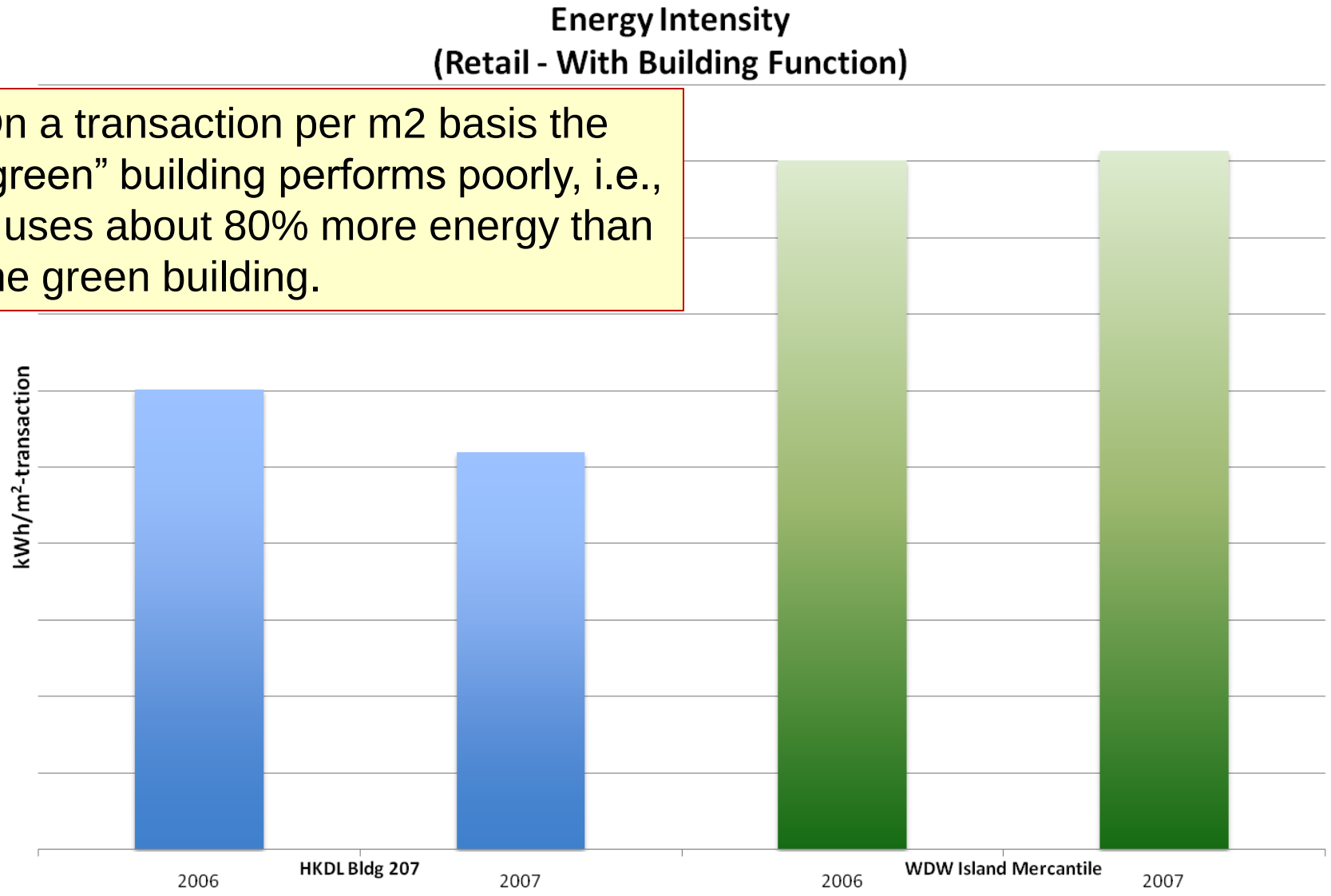
Suggestion - choose units carefully: cost vs. list-cycle cost vs. value

	First cost (related to initial investment, design and construction phase)	**Lifecycle cost** (LCC)/Period -- 20, 30, or whatever # of years	**Lifecycle cost per value earned** (e.g., per person-occupancy-hour, $ of profit, patient treated, …)
Cost ($ or hours)	First cost/sf	LCC/sf	LCC/value metric
Energy (kBtu)	Kwh construction/sf	Kwh/sf	Kwh/value metric
CO2 (tons of CO2 equivalent)	tCO2 embodied in product (including CO2 from production, transportation)	tCO2/sf	tCO2/value metric
Quality (% conformance to explicitly stated design intent, normalized by item relative weight)	Cost of design and construction services plus interest on any loans	Productivity cost of workers who must compensate for quality deficit	Productivity cost of workers who must compensate for quality deficit/value metric
Safety (Incidents or lost-work hours)	/Msf; project cost of workers comp insurance	/Msf; operational cost of workers comp insurance; /hr of operation; /work hours of operation	/value add of facility
Schedule Duration (Weeks)	Cost of design and construction services + interest on any loans	n/a	Additional income (loss) because of schedule gain (delay)
Schedule Conformance (%)	Cost of contingency to account for schedule variability	n/a	n/a



On a m2 basis the “blue” building performs poorly, i.e., it uses about 50% more energy than the green building.

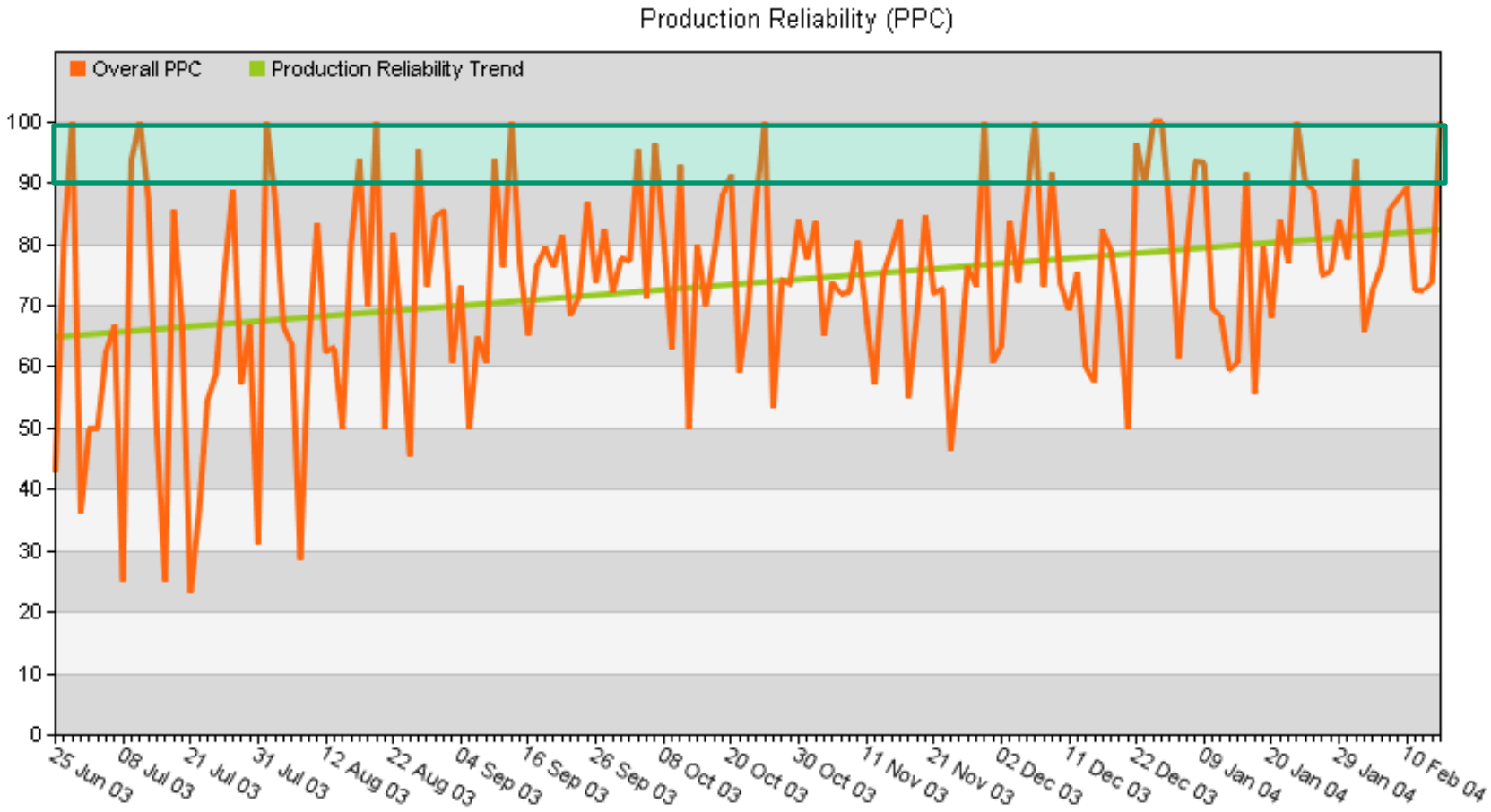
Figure Courtesy, WDI



On a transaction per m2 basis the "green" building performs poorly, i.e., it uses about 80% more energy than the green building.

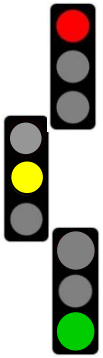
Figure Courtesy, WDI

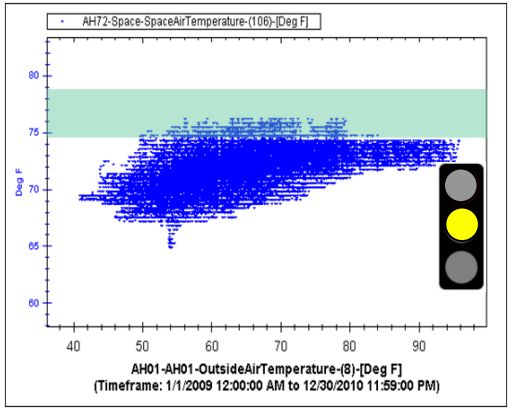
Metrics – Production Reliability: Notice variance reduction; improved mean



Suggestions on process and outcome metrics

- Focus on a small manageable set (>= 7)
- Display and interpret them publicly and explicitly
  - Show objective and data
  - Add traffic light to show status
  - Add comments to explain *why* yellow or red status
- Continually reassess how metrics can and do support management





Comments from VDC Value Survey:

Projects often do not track and manage using quantitative performance metrics today

- Quantitative impacts remain largely invisible – VDC seems to sell itself
- Quantitative data response low
  - 90% do not quantitatively track impacts
- Most respondents do not know cost performance!!
- Half of participants do not know performance!!

How to use business objectives

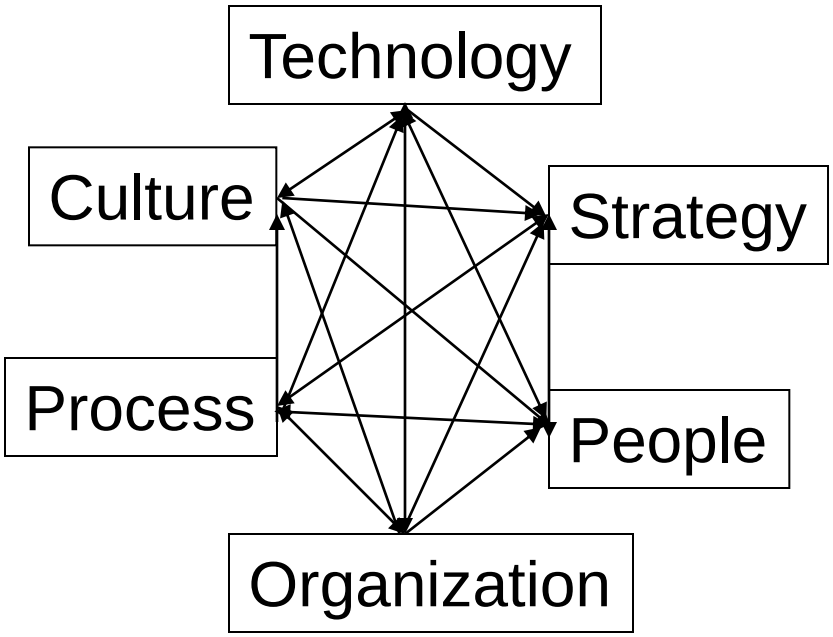
- Understand the options
- Select ~5 each for focusIStrategy
  - Controllable: (VDC Scope, stakeholders)
  - Process: (schedule, cost, quality, delivery, stakeholder participation)
  - Project: (scope, cost, quality)
- Report status explicitly, publicly
  - Value(s), trend line, variance
  - Objective
  - Status wrt objective (traffic light)
  - Root causes
- Set explicit, public objectives:
  1. Reduce variance
  2. Improve mean
- Manage process, project to improve selected metrics:
  - Make controllable change
  - Plan, track, manage plan vs. actuals

- VDC strategy and plan
- Coordination activity
- Design versions:
- Risk management strategy
- Globalization strategy and plan
- Cost estimates
- Schedule
- Cost
- Field material delivery timeliness
- latency
- Field-generated RFIs
- Rework volume:
- Meetings
- Safety
- Schedule
- Cost, Scope
- Sustainability
- Globalization

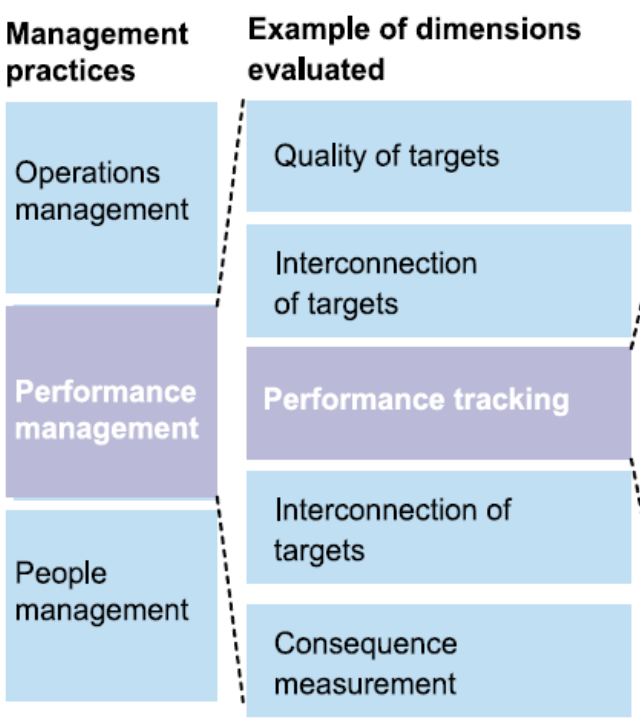
Meeting new Performance Objectives

Integrated business approach

- Culture: public commitment; public performance reporting
- Technology: predict, track
- Strategy: unique value
- People: skills, incentives
- Organization: structure
- Process: planning, execution, objectives



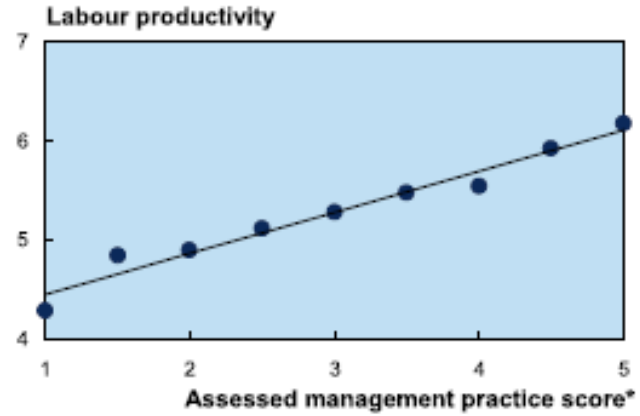
Metrics improve Management practices

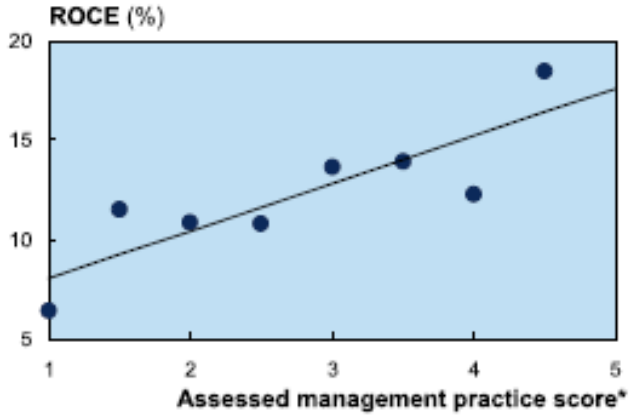


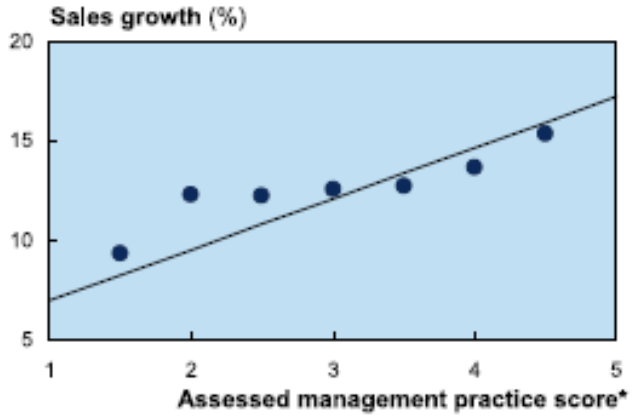
	Dimension scoring criteria	Examples
1	*Measures tracked do not directly indicate if overall business objectives are being met. Tracking is ad hoc*	*A wood products manufacturer tracks a range of measures when he thinks output is insufficient. He last requested these reports about 8 months ago and had them printed for a week until output increased again*
3	*Most key performance indicators are tracked formally. Tracking is overseen by senior management*	*At a weapons manufacturer, every product is bar-coded and performance indicators are tracked throughout the production process; however, this information is not communicated to workers*
5	*Performance is continuously tracked and communicated, formally and informally, to all staff, using a range of visual management tools*	*A U.S. industrial manufacturer has plasma screens in view of every line to display progress toward daily targets and other performance indicators. Managers meet with the shop floor every morning to discuss the day before and the next day. They use monthly meetings to present an overview of the goals to date, and the strategic direction of the business. They also stamp canteen napkins with key performance achievements so everyone is aware of a target that has been hit*

- Management Practice & Productivity: Why they matter, Nick Bloom et al., McKinsie

Management: Company performance follows management quality in 4,000 companies [Bloom]







Firms are grouped in 0.5 increments of assessed management score

Nick Bloom, Management Practice & Productivity: Why they matter.

Qualitative Benefits using metrics to manage

- Greater level of interaction between office and field re planning and reliability
- Improved communication among engineers and between engineers and foremen
- Improved process understanding of how work is completed at detailed level and consequent planning
- Better offline work planning and structuring via multidisciplinary teams
- Desire to improve project business processes to eliminate waste in the overall production system – teams engaged in continuous improvement
- Increased understanding of workload capacity leading to increased productivity
- Feeling of empowerment among site teams to influence and own the plan (people help to implement what they help to create!)

VDC Big Ideas

- Build project model early and often, before committing large money or time
- What
  - Product, Organization, Process (POP)
- How:
  - Virtual: in the computer
  - Visual: multi-discipline, multi-view, for multiple stakeholders
  - Objective-based: set and track explicit public objectives
  - Detailed: 10% (2%) of project time, money, risk

Metrics Implementation table

Metrics table sheet in POP model

	Name	Objective	Type [C, P, O]	How to use in management	Source of data	Display	Collection frequency
METRICS							

Type: Controllable, Process, Outcome

Display: Bar chart; Time line; Spider, …

For ICE Session on use of Metrics on your project

Create ppt summary of your intended uses of metrics on your project:

1. Controllable factor and Metrics implementation tables in POP model
2. Comments:
   - Recommend next steps for modeling, analysis, new tools, new competences to enable metrics
   - Identify expected managerial results, methods of metrics
   - Relate metrics plan to your VDC implementation plan

Controllable project execution factor	Responsible Stakeholder	Enabling resources/ tasks

	Name	Objective	Type [C, P, O]	How to use in management	Source of data	Display	Collection frequency
METRICS							

Metrics Overview

Session	Objectives
Metrics [Lecture/ discussion; Demo; interactive planning session]	Understand and experience: • types of metrics, including project outcome objectives, process performance, and controllable factors • how to track them • methods to use them in management • entering metrics into the POP and associated modeling tools.

ORID: Focused Conversation and Analysis

Objective What do you recall seeing?	**Reflective Positive** What do you feel positive about?	**Reflective Negative** What do you find negative?	**Interpretive** What sense do you make of it?	**Decisional** What agreements can be made now?

Performance Metrics in AEC

The big idea: Progress in AEC effectiveness and efficiency comes from achievement of measurable goals

You may get what you ask for