It IS Broke. Fix It!

The Comprehensive Business Improvement Toolkit

David M. Connaughton

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Cover photo of the Swiss Army Knife used with the kind permission of Victorinox AG.

To the ROI-Team
investors and advisors for
your friendship, wisdom,
and unflagging support.

Contents

Available CD ROM Supplement

Many of the tools referenced in this book can be obtained in ready-to-apply form on a CD or via electronic download from ROI-Team, Inc., at ROI-Team.us. In addition, the CD ROM contains PowerPoint slides summarizing each chapter, for reference or for training purposes.

The tools are written in Microsoft Excel for the PC, which includes the capability to create 'Macros,' built-in code that automates actions on spreadsheets (using the Visual Basic for Applications, or VBA programming language). This code DOES NOT RUN ON APPLE APPLE OPERATING SYSTEMS.

CD ROM Contents

01	Survey Instruments	What are they thinking?
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The MS Excel files listed here contain all of the tables and tools illustrated and described in this book. Most are unprotected or protected without a password (leave the password entry field blank) so that you can modify them as needed.

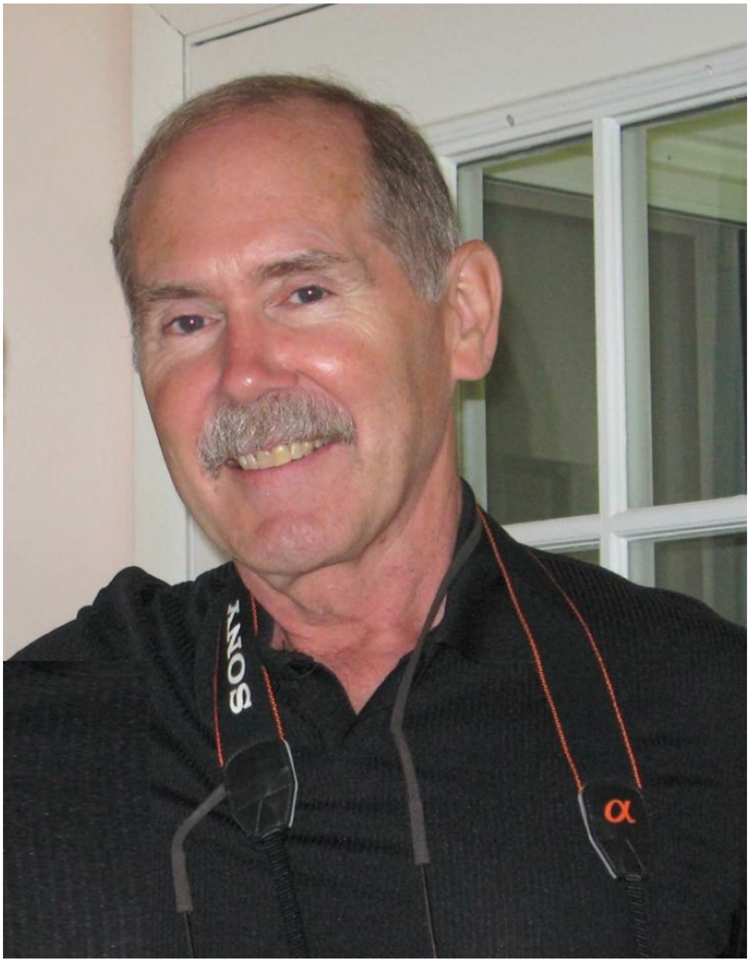
Acknowledgements

This book represents the culmination of many years of experience with a wide variety of enterprises and industries, and much of the material is adapted from the work of my many friends and acquaintances among the ranks of hands-on consultants and business executives. Especially noteworthy are the late Hans-Peter von Sicard, a consultant's consultant and mentor to many; the well-known lean author and expert Dr. Bill Lareau, who writes books like others write e-mails; Roger Kaufman of Implementation Services, who is a role model for how entrepreneurs should drive and persevere; Dr. Neil Parmenter, Dean of the Business School at Daniel Webster College; Bob Carlson, the chief content editor as the work progressed over the years; and a list of colleagues too numerous to name here but greatly appreciated nonetheless.
Source references appear on pages where interesting concepts and facts were added for color or completeness, and the Sources are listed in the rear of the book. Thanks especially to the great contributors and editors of Wikipedia.com for the completeness and accuracy of their business topics, providing well- structured articles and reliable leads to useful sources.

Thanks to my wife Marilyn for her support and occasional proof-reading, to the investors of ROI-Team, Inc., whose trust and patience have generated a business rationale for this work, and to my many students who provided so many opportunities for improvement. All these have helped create whatever in this book is useful and accurate; any errata can be attributed directly and solely to the author.

About the Author

David Connaughton is an international management consultant and business school adjunct professor with a long-running passion for operational excellence. He is a graduate of the United States Air Force Academy and the Harvard Business School and resides in Windham, New Hampshire.



Introduction

For most business operations, the old adage, “If it ain’t broke, don’t fix it” does not apply. In an ever-changing business environment, it is NEVER completely right, and too often dangerously wrong. While there are few business operations that cannot be improved, few managers are equipped to deal effectively with the broad range of challenges and opportunities we all routinely face, and spectacularly bone-headed decisions through the years illustrate the high cost of incompetence. These may result from hubris, as when Napoleon and later Hitler decided to invade Russia, or from misread information, as when Ford got excited about the Edsel and IBM failed to get excited about the PC market. But It is the ubiquitous small bone-headed decisions that have more impact on our daily work and personal lives, and we can do something about them.

Every business professional needs to be an effective participant in recognizing business problems, making informed decisions, and improving business operations. This book is about an approach designed to avoid bad outcomes, and introduces nearly every tool and technique required to dramatically improve the operations of any part of any business. It addresses the three things every business person needs to make consistently masterful business decisions:

- An understanding of the context (a framework) for making business improvement decisions,
- Facility with a wide range of tools to expose the roots of problems, and
- People skills to lead teams to success.

Of course, luck also plays an important role in every decision, but fortune favors the prepared!

Why so many Japanese terms in Lean and Six Sigma?

Many of the Lean and Six Sigma practices existed from antiquity, but without a common lexicon they were applied piecemeal at best. The Japanese were the first to codify and actually follow the disciplines required (see the Lean 'genealogical' chart on page 28) so they acquired the naming rights, and their terms have been widely used since the 1970s.

Overview of Topics

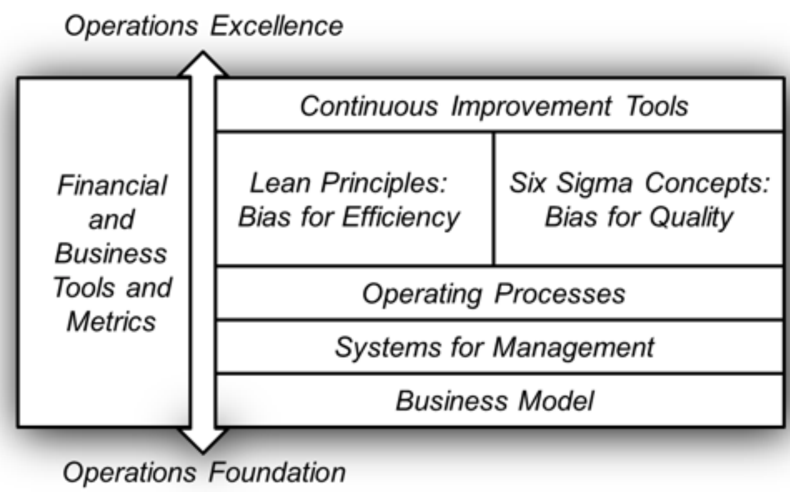
Elevator Pitch

"For career survival, every serious business person needs to understand how modern business works."

The foundation of a business, profit or non-profit, and regardless of its industry, is its business model – how it serves whom to stay in business. It must then determine how it will manage itself, and then what set of processes will accomplish its mission. To enable continuing operation, it needs financial controls and metrics, and every business person with career aspirations needs to be financially literate.

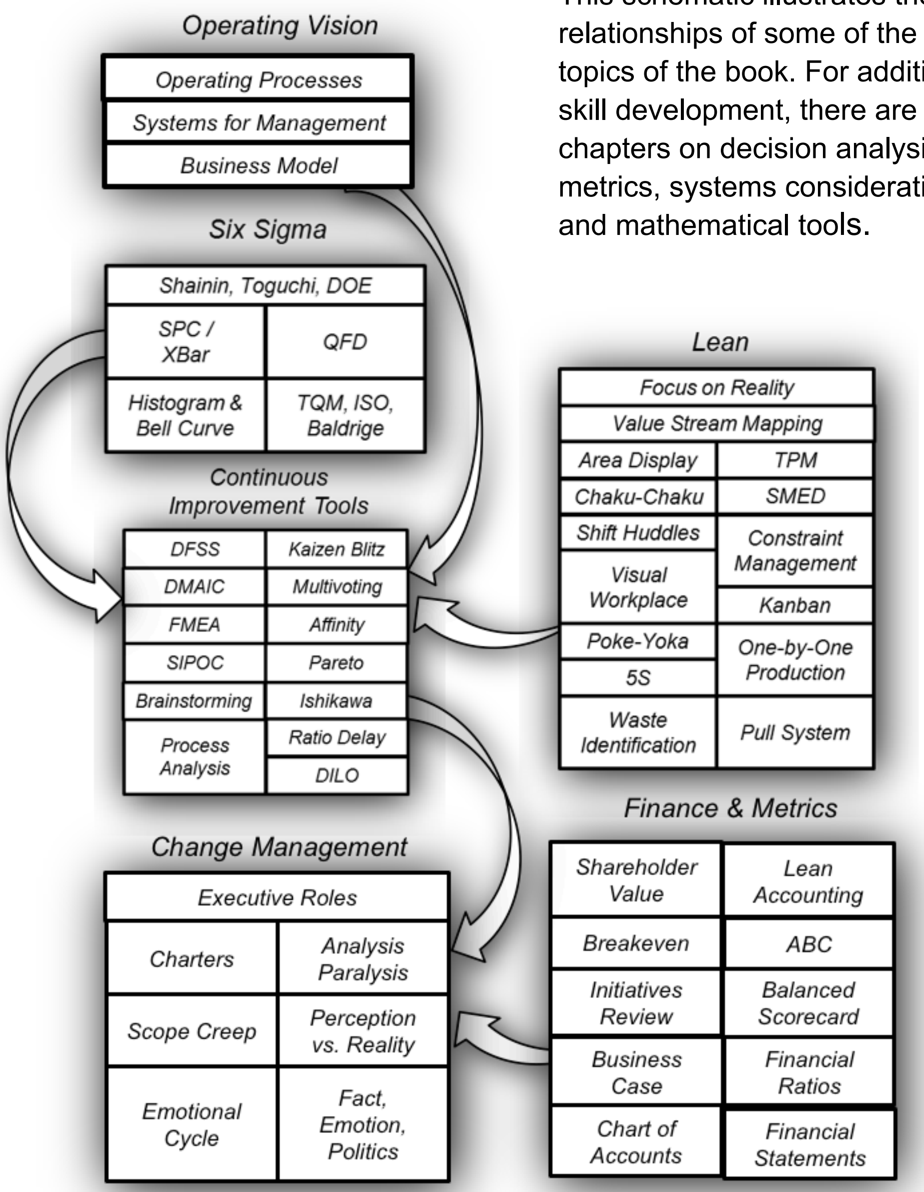
To stay in business, a company needs to provide a quality product efficiently. The concepts and tools of Six Sigma address the topic of quality, producing what the customer wants reliably, and those of Lean focus on efficiency, relentlessly eliminating waste. To accomplish these objectives a number of 'best practice' tools have evolved, some known as belonging to 'Six Sigma,' some to 'Lean.' In fact, the two philosophies are not only compatible, but also co-dependent. It makes no sense to efficiently develop low quality products, nor can high-quality products be reliably and affordably created in a loose and flabby plant.

This schematic of the many highly integrated facets of business is intended to suggest logical starting points for operating improvement activities.



Organization of Topics

This schematic illustrates the relationships of some of the key topics of the book. For additional skill development, there are chapters on decision analysis, metrics, systems considerations, and mathematical tools.



Using This Book

You may wish to study this book in detail as a course or use it as a handy reference describing virtually every concept and tool used by successful entrepreneurs, executives and general managers, and Lean and Six Sigma masters. Sources and additional suggested reading are at the back of the book.

The available CD- ROM by ROI-Team follows this text with illustrations, examples and ready-to-use tools in Excel format.

<u>Elevator Pitch</u>

Many pages of this text include a very brief synopsis of the material, useful when the CEO catches you on the elevator and asks, “What is this thing called…?”

Being good counts most
if you also look good!

<u>Step-by-Step</u>

Many of the tools and techniques covered in this book benefit from an organized approach to execution. When called for, this step-by-step sidebar outlines that approach.

Create an Operating Vision

About the Vision Tool

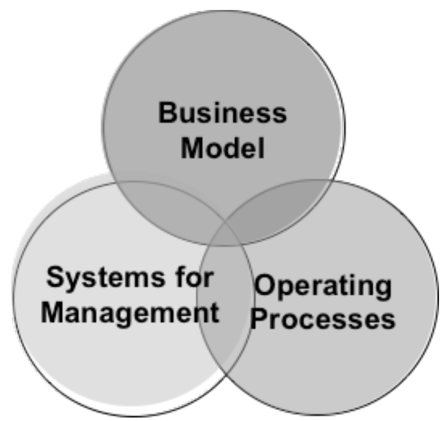
The Vision Tool is a compilation of multiple tools and techniques designed to guide a high level analysis of virtually any business, to be applied whenever improvement is needed. It is not about a catch-phrase to focus employees, but rather about a view of how the business should function. The workings of the tool are described here, and worksheets to apply the tool are provided on the available CD-ROM.

Elevator Pitch

"An operating vision – of how a company makes money, manages itself, and executes its processes – shared by most or all employees greatly facilitates communication and cooperation for success."

The Vision Tool encompasses three elements describing how well the business works, as illustrated here:

1. Business Model: Is the company positioning itself for maximum success in its industry?
2. Systems for Management: Are executive and management structure and practices optimal for success?
3. Operating Processes: Are the work processes optimal for delivering value effectively and efficiently?



An organization's specific vision for the future can be developed from the aspirations of its people, recognizing the cultural factors that will influence timing and sequencing. A road map to achieve the vision can be based on the gaps and their significance, and sequencing must address root causes (foundational elements) as well as cultural readiness for change. A business case will be needed to consider the estimated costs and benefits of the road map. All of these tools and techniques are described in this book.

Business Effectiveness Attributes

Step-by-Step

Survey to determine how well-developed and effective the vision is:

1. Identify the key movers in the company, generally the 'C' (Chief Executive) team, plus highly-regarded managers and thought leaders
2. Using the 'Vision Tool' survey instrument on the available CD, create a chart of responses including an accurate 'As Is' view and an aspirational 'To Be' view
3. Analyze the gaps, for the whole survey population and comparing one demographic versus another (e.g., workers vs. executives)
4. In a working session with the executive team, explore gap priorities and possible projects to close key gaps
5. Iteratively develop a path forward with the executives, addressing foundational weaknesses as well as high-impact fixes

Every organization needs a 'business model,' describing why it exists and how it serves its customers. For commercial enterprises, this describes how it makes money. Secondly, it needs sound management in a sound structure. Thirdly, it requires processes that effectively and efficiently execute its business model. For each of these aspects of business, key attributes have been defined. These key attributes vary by business, but the set in this chapter is generally useful as a starting point for analyzing commercial enterprises.

For each attribute, a set of five maturity descriptors will help the analyst identify weaknesses and determine where to focus improvement projects. Each attribute can be evaluated in terms of how well or poorly it is executed. Descriptors on the maturity grids suggest a progressively better executed (more mature) operation (1 is low, 5 is high). Insiders will have strong and often accurate opinions, so a survey based on these maturity grids is a useful analysis starting point. Perceptions can then be tested against independent evaluations, and any misperceptions can be addressed as part of a change management program.

In evaluating a company's Business Model, look for the clarity and intuitive nature of the model; broad understanding and alignment with cultural norms; and resources allocated to each attribute.

Systems for Management should show strong leadership presence; logic and clarity of organization structure, policies, and practices; and an educated and resourceful workforce.

There should be a clear, logical process flow, clear, logical roles and responsibilities, minimum errors, wheel-spinning and rework; minimum wasted motion and unnecessary activity; reasonable flow speed; care appropriate to the value passing through critical processes; and minimum wait time.

Maturity Grids

Maturity grids can help organize ideas about an organization’s effectiveness, and communicate those ideas. Following are maturity grids for each of the three Vision Tool elements.

Business Model Maturity Grid

		1 - Weak	2	3	4	5 - Strong
1	**Business Intelligence** - competitive analysis and Benchmarking to ensure optimum capabilities	Little concept of competing companies or technologies. No benchmarks for any aspect of the business.	Occasional competitive analysis and benchmarking.	Benchmarks are commonly used to ensure practices are competitive.	Ongoing competitive analysis and benchmarking provide assurance that the organization is effective and efficient.	All competitive actions and capabilities are analyzed and incorporated in strategic plans.
2	**Voice of the Customer** - customer feedback and market analysis to ensure products and services are well targeted	Little understanding of what customers / potential customers want or what they need.	Customer satisfaction surveys are used occasionally to deal with suspected problems.	Customer feedback informs all major product and market actions.	Customer surveys include rewards to customers for providing product improvement insights.	Formal programs ensure that customer attitudes, wants and needs are fully understood and used in product / market plans.
3	**Strategic Direction** - vision, and the strategies to achieve it	No clearly articulated vision of the future or strategy to ensure success.	Executives have a shared vision and a published strategy, but not widely shared.	The vision and strategy are clearly articulated to the organization.	Vision and strategy are developed with input from leaders throughout the organization.	Strategic direction is set using processes that ensure the best intelligence and ideas of the whole organization are incorporated.
4	**Financial Management**- accounting, control, cash planning, and profitability analysis	Bookkeeping, basic financial statements, limited financial metric tracking.	Strong accounting and control disciplines ensure accurate and timely information.	Budgets, variance reports and key ratios ensure spending is controlled and sensible.	A clear and well-designed financial analysis package provides the right metrics at the right time to each decision maker.	Focus is on shareholder value through ongoing analysis of operations, investments, and capital sourcing.
5	**Capital Investments** - capital productivity analysis and ROI analysis	Limited capital planning, without substantial business cases for CAPEX.	Business cases are used for spending decisions, each case treated as unique, and analysis approaches often reinvented.	Major investments are evaluated using sophisticated business cases.	Standardized business cases provide a level playing field for all capital investment decisions.	Capital investments are continuously analyzed to ensure optimum configuration for return on investment.

Systems for Management Maturity Grid

		1 - Weak	2	3	4	5 - Strong
6	**Organization Structure-** spans of control, functional skills and process alignment	Legacy organization structure may or may not meet any particular functional or operating requirements as the business evolves.	Organizational structure is redefined to resolve specific problems, building on the strengths of specific individuals.	Organizational structure is based on norms (such as spans of control) for the type of business, and benchmarks/consultants help when changes are needed.	The organization is matrixed, with strong leadership of functions and of processes.	Processes are continuously improved and organization structure is continuously aligned for functional excellence and process efficiency.
7	**Decision Making Processes -** authority structure, formats, and practices	Executive and management decisions by gut feel. Weak controls and uncoordinated criteria.	Sound controls are in place, with clear approval authorities and commonly understood (but informal) criteria in place.	Decisions are made at appropriate levels based on appropriate data, but often take excessive time.	Executive focus has improved the decision process. Most decisions are timely and appropriate based on relevant data.	Optimum decisions are made quickly following clear processes with clear criteria.
8	**Communications & Alignment -** audiences, media, and messages	Most operating information is promulgated ad hoc following personal relationships.	Formal communications are sent regularly but without targeting, resulting in information overload.	Key information is well-managed, but important information is sometimes missed.	Most information is available when and where needed, through multiple formal and informal methods.	Communications are well-managed to ensure operations are coordinated and the organization is aligned.
9	**Human Relations Policy & Practice -** rewards and recognition	Human resource management is not seen as strategically important.	Key HR activities such as hiring and firing are highly valued and effectively managed. The policy manual is current and accessible.	HR effectively manages employee needs and plays a key role in rewards and recognition.	HR leads training efforts to ensure all critical skills are available at all times.	HR is organizationally positioned as a critical part of the business.

Systems for Management (Cont'd)

		1 - Weak	2	3	4	5 - Strong
10	**Executive Sponsorship** - visibility and focus	Executives are rarely visible to the workforce.	Executives kick things off but are generally difficult to involve in day to day action.	Executives practice 'management by walking around,' and are aware of all key activities in their areas of responsibility.	Executives sponsor key activities and participate as needed to make things work.	Executives are clearly visible sponsoring every critical activity of the organization, especially business changes, and participate in cross-functional steering teams.
11	**Scheduling & Priority Setting -** schedule management, emergency management	Firefighting is common, and work schedules are routinely interrupted.	Schedules are well-managed, but can be badly disrupted by emergency work.	The scheduling process anticipates emergency work, but excessive overtime still occurs routinely.	Scheduling is a focus area, and a rapid decision process supports schedule interruption decisions.	Priorities are so well managed that schedules are seldom interrupted and deadlines are routinely met without stress.
12	**Hiring, Retention, & Succession Planning -** critical skills coverage and continuity	Retirements and unplanned absences can bring the operation to its knees.	Desk procedures and common knowledge repositories ensure retirements and unplanned absences do not impact critical tasks.	Training programs are designed to build skills progressively, with a pipeline of candidates for every planned vacancy.	Building and maintaining critical skills is seen as a strategic activity, and executives participate as needed to ensure uninterrupted capability.	Retirements and unplanned absences have little effect on the business, and critical skills will remain secure.
13	**Education, Training & Skill Flexibility -** training program, task competence, work interruption	Few employees are fully trained for their work and almost none are cross-trained.	Functional departments have cross-training programs to ensure department work is never stopped by an absence.	Job rotation creates informal workforce flexibility, with many people capable of filling in for multiple tasks across functional lines.	The organization focuses on cross-training, and employees are rewarded for broad skills serving multiple process tasks. Skills are formally tracked to anticipate skill needs.	All employees are fully trained for their work and multiple resources are skilled for every significant task in every key process.

Operating Processes Maturity Grid

		1 - Weak	2	3	4	5 - Strong
14	**Marketing & Sales -** Income generation and sales funnel management	There is no sales funnel tracking, and future sales are highly uncertain.	The sales funnel is defined and unambiguous roles are established for every step.	Quotas are set and followed up to ensure prospects move through the sales funnel.	Realistic quotas are set for every step of the sales funnel, and regular meetings highlight issues early and effectively.	The sales funnel is managed to ensure optimum profitability and growth.
15	**Work Practices -** Standard work and team daily practices	There is no 'standard' work, and no routine method to coordinate work across departments.	Every desk has standard procedures, and all normal tasks are well documented.	Processes are documented and tasks within the processes well defined.	Processes are streamlined and tasks are distributed effectively.	Standard work and 'shift huddles' ensure all work is effectively focused and efficiently performed day to day and for special projects.
16	**Supply Chain-** supplier programs, material movement, and transportation management	Suppliers are not managed formally, even for critical parts. Transportation is treated as a commodity.	The supply chain is mapped and roles are understood.	Suppliers are well-managed, with preferred status and blanket orders routinely applied.	All suppliers, internal and external, are well aware of expectations at all times.	Critical suppliers and transporters are trusted partners, and everything flows smoothly.
17	**Supporting Technologies -** computer systems and information management	Information systems are an uncoordinated kludge, and critical information is routinely unavailable.	Information systems are integrated and information is readily available.	Information is well-organized and easy to access.	Information is organized and structured for hierarchical analysis.	Information is always available when and where needed in an optimum form for immediate use. Critical information is proactively delivered to decision makers.
18	**Process Management -** process definitions, flow charts, and process ownership	Processes do not have clear definitions, flow charts, or owners.	Processes are defined and some critical ones are mapped.	Processes are routinely analyzed in order to resolve flow issues.	Most processes are well defined and mapped. Critical processes have owners.	Processes are well defined, mapped, and streamlined, and there are clear owners.

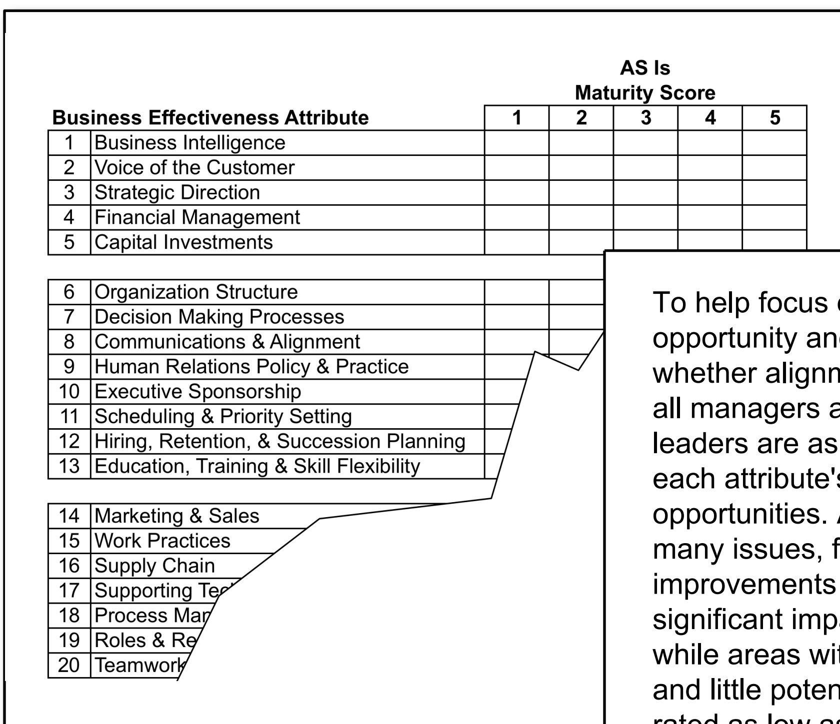
Operating Processes (Cont'd)

		1 - Weak	2	3	4	5 - Strong
19	**Roles & Responsibilities -** accountability, responsibility, consulting and informing	There is commonly confusion about accountability or responsibility for any task, and who to be consult or inform.	Tasks have assigned owners.	Task owners have established and generally understood methods for coordinating their work.	Critical task owners have published RACI (responsible, accountable, consult, inform) lists.	Everyone always knows what they are expected to do, and who to coordinate with for every task.
20	**Teamwork & Integration -** daily work and continuous improvement	'Every man for himself.'	Critical tasks are handled by teams, and teams are rewarded for effective handling of critical processes.	Business improvement is typically handled by cross-functional teams.	Every department sees itself as a team, and every process is seen as a team activity.	Daily work and business improvements are routinely accomplished by cross-functional teams with all the right skills.

Maturity Survey

The Maturity Survey is the initial step in creating a snapshot of company effectiveness. The participants will certainly have some misperceptions and biases, but with enough participants this survey always adds insights into an organization's overall strengths and weaknesses, and establishes a framework for setting improvement priorities.

The Vision Tool survey instruments on the available CD include a Change Readiness survey, a Leadership Alignment survey, and the sheet shown here, which covers the 20 attributes of business effectiveness we have just reviewed. Participants are asked to rate current performance and desired ('should be') performance. These surveys can all be completed prior to other investigations, and will help guide further diagnostics, including more targeted surveys if appropriate. On this form, 1 is low, 5 is high.



AS Is
Maturity Score

Business Effectiveness Attribute		1	2	3	4	5
1	Business Intelligence					
2	Voice of the Customer					
3	Strategic Direction					
4	Financial Management					
5	Capital Investments					
6	Organization Structure					
7	Decision Making Processes					
8	Communications & Alignment					
9	Human Relations Policy & Practice					
10	Executive Sponsorship					
11	Scheduling & Priority Setting					
12	Hiring, Retention, & Succession Planning					
13	Education, Training & Skill Flexibility					
14	Marketing & Sales					
15	Work Practices					
16	Supply Chain					
17	Supporting Te					
18	Process Mar					
19	Roles & Re					
20	Teamwork					

To help focus on areas of opportunity and to demonstrate whether alignment is an issue, all managers and thought leaders are asked to evaluate each attribute's improvement opportunities. Attributes with many issues, for which improvements could have significant impact, are rated '5' while areas with few problems and little potential impact are rated as low as '1.'

It is critical to ensure that all participants understand why the survey is being done and where it may lead. In cases where serious problems are obvious, it will make more sense to start with a more targeted survey, but a survey is always useful to ensure the people - who in the end will make change happen, or not - know that their knowledge and ideas are valued. Following is an example of an introductory paragraph attached at the opening of the survey.

Sample Letter to Survey Participants

"This survey is provided to a random sample of experienced professionals in order to gauge, at a very high level, areas in our organization that might benefit from deeper analysis and improvement actions. Please refer to the attribute maturity grids provided and on this survey page mark one maturity box for each attribute, as it currently is and as it should be (desired state).

"We also ask you to consider the significance of opportunities for each attribute. If there are many problems and improvements would significantly improve how well the company operates and how much profit it earns, it could be considered high (5) significance. If there are few opportunities and little to be gained by investing resources and funds, it could be considered low (1) significance. Your input is used for two purposes:

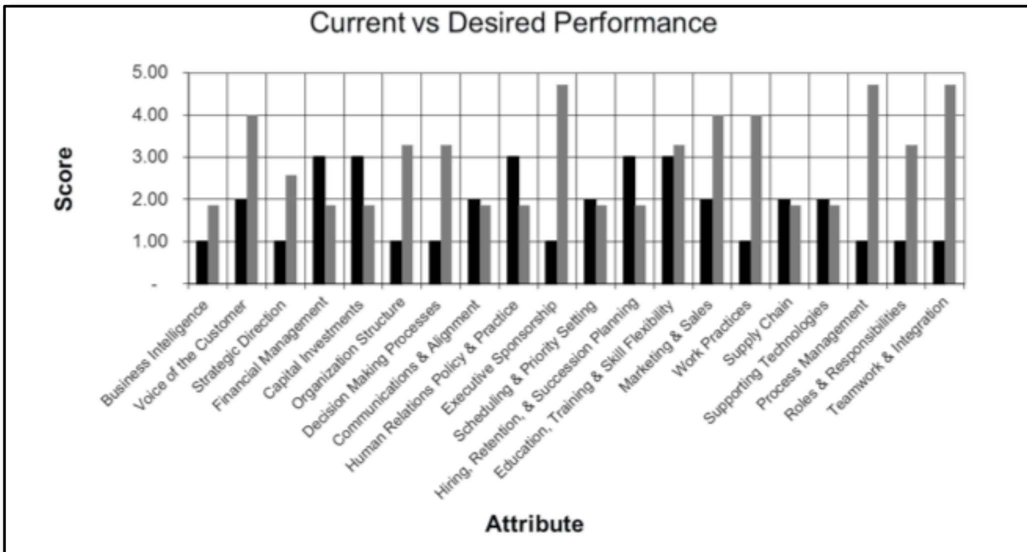
1. *To determine where, in the opinion of employees, the company should concentrate improvement efforts, and*
2. *Whether the organization is aligned with regard to what should be done.*

"You may be asked to complete other surveys dealing with Leadership Alignment and Change Readiness. These, too, will help us, as a team, focus our efforts most effectively.

"All surveys are held in strictest confidence, and only statistical results will be presented to management. Your participation will help all of us to improve our competitiveness and working environment. Thank you!"

Business Effectiveness Results

This chart of Maturity Survey data offers an intuitive profile of business effectiveness. The score for each item ranges from 1 (least mature) to 5 (most mature). There are 20 attributes, so the minimum score is 20 and the maximum is 100. This provides a straightforward way to define the current state, an ideal state as a vision of future effectiveness, and a road map for improvement. Note that this profile can serve to design a specific improvement effort or, updated as improvements are incorporated, as an ongoing perspective for continuous improvement.



The vision needs to encompass specific metrics and milestones to be achieved around each attribute, both to ensure it can be tracked and to ensure everyone understands exactly what success looks like. However, vision and road map documentation must be easily read and understood to have an impact - less is more. In any project and especially for long-term vision achievement, it is important to set realistic project goals to ensure early successes, in order to build a culture of enthusiasm for change. The effectiveness profile can help to conceptualize an integrated program with quick hits, foundation building, and continuous improvement.

Demographics

The quality of survey results varies significantly with the viewpoints, skills, and attitudes of the respondents. In general, this survey should be offered to leadership and to employees that want the company to succeed and have knowledge relevant to the survey content. The demographic (and attitude) questions here are intended to facilitate analysis of the results. Purely demographic data can help to locate focus areas and target audiences, while the attitude questions will help to determine how responses are affected by positive or negative outlooks.

Department/Function	
Position (Executive, Manager, Professional, Other)	
Location (Division, Geography)	
Years with Company	
Age	
Sex	

	1	2	3	4	5
People in this company are trustworthy					
People in this company are highly skilled					
Executives of this company are well respected					
Managers in this company are well respected					
This company has a bright future					

A statistically useful sample depends on the size of the organization, but in our experience little new is learned beyond the collected wisdom of the top 25 - 50

What Does This Vision Look Like?

The vision of many organizations consists of a few lines of platitudes used to bind the organization philosophically at the highest level, but not very informative if specific operating and improvement strategies are needed. One approach is to use the Business Effectiveness Attributes to create a vision of how the managers and workforce of an organization would like their organization to operate. Reading the 'vision' statement shown below, one can envision what it would be like to work in such an organization, serving customers without undue angst and without missing a beat.

The reality, of course, is that very few organizations even come close, so the ideal state remains a goal. However, gaps between current reality and the vision can be addressed in a logical manner to ensure continuing progress, one attribute at a time.

Every organization has its unique vision, especially around its business model. However, the Business Effectiveness Attributes provide a useful structure for a detailed vision. For example:

Business Model

- Our competitive knowledge and benchmarking indicate we are in the top quartile of our industry in our areas of unique capability, namely ...
- Our customers value our products and services and actively help us improve them
- Everyone in our organization can articulate our vision and describe their role in achieving it
- Etc.

Systems for Management

- Our organizational structure facilitates process effectiveness and functional excellence
- We make correct decisions quickly
- Employees are very satisfied with their work, rewards, recognition, and prospects here
- Executives are visibly appropriately engaged in day to day work and in continuous improvement activities
- Etc.

Operating Processes

- Our marketing efforts and sales funnel are managed to ensure a steady and growing stream of business
- Every employee has and knows his/her desk procedures, and every team has regular effective meetings to ensure coordination and continuous improvement
- Our suppliers are our partners in ensuring the smooth flow of finished products to our customers
- Etc.

Closing the Gaps

Using the Vision Tool, and Hoshin Planning (page 20), most organizations can identify significant gaps between their current performance and the performance they aspire to. Categorizing these by attribute or core competence desired, they can begin the process of specific and continuous improvement with a plan in simple, easily communicated format. The plan can be formulated in a series of executive workshops with an experienced facilitator.

In the example shown here, gaps have been identified directly from the Vision Tool survey instrument, and typical improvement tools and concepts have been identified to close the gaps. Executives have then prioritized these based on areas of perceived opportunity, informed also by the cost and difficulty of solutions.

This array of solutions and priorities forms the basis of a very high level strategic improvement action plan – the road map (page 22).

	Business Effectiveness Attribute	Current	Desired	GAP	Priority	Action Plan
1	Business Intelligence	1.00	1.00	-	2.00	TBD in 6 months
2	Voice of the Customer	2.00	1.86	- 0.14	3.50	Kaizen event in September
3	Strategic Direction	1.00	4.00	3.00	1.86	Leadership workshop ASAP
4	Financial Management	3.00	2.57	- 0.43	2.13	
5	Capital Investments	3.00	1.00	- 2.00	1.45	
6	Organization Structure	1.00	3.29	2.29		
7	Decision Making Processes	1.75	3.29	1.54		
8	Communications & Alignment	3.00	1.86	- 1.14		
9	Human Relations Policy & Practice	1.00	4.71	3.71		
10	Executive Sponsorship	2.00	1.86	- 0.14		
11	Scheduling & Priority Setting	3.00	1.70	- 1.30		
12	Hiring, Retention, & Succession Planning	1.50				
13	Education, Training & Skill Flexibility					
14	Marketing & Sales					
15	Work Practices					
16	Supply Chain					
17	Supporting Technologies					
18	Process Management					

Hoshin Planning

> **Elevator Pitch**
>
> "Hoshin planning aligns an organization around its main goal by identifying strategies that support the goal, critical success factors behind the strategies, and core competencies required to achieve the success."

The hoshin kanri ('direction management') planning process supports the vision of a quality organization by systematically defining mid-term (two to five year) breakthrough objectives and the strategies that will make it possible to achieve the objectives, and then linking them to current fundamentals required to run the business successfully, fostering continuous improvement of the key business processes.

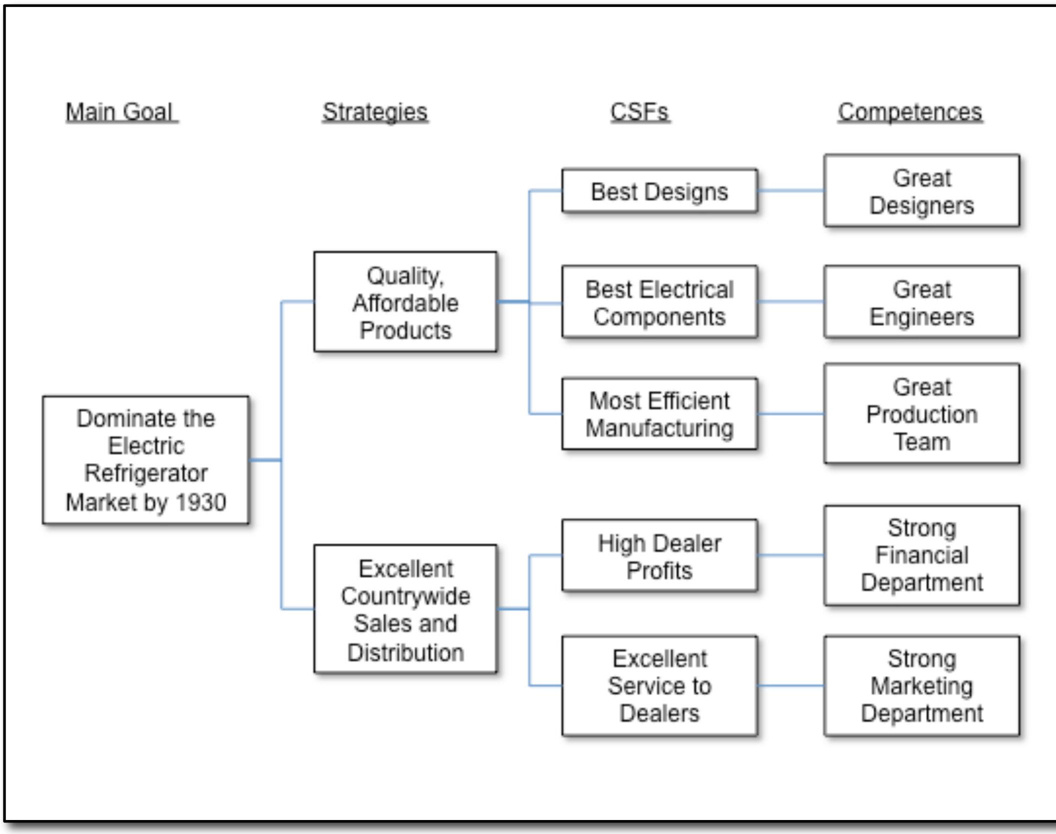
The process is intended to get executives, managers, and all other employees aligned and focused on short term effectiveness and efficiency in the context of longer term fundamental direction. It is based on Japanese Professor Kaoru Ishikawa's 1950s concept that people are the best expert in their own jobs and the collective ideas of all employees are needed to optimize an organization's operations. [8]

The hoshin methodology provides:

- Breakthrough objective focus
- Development of strategies that adequately support the objective
- Review of progress
- Changes to plans as required
- Continuous improvement of key business processes
- A vehicle for organizational alignment and learning

Hoshin ensures that everyone in the organization is working toward the same end. The plan is hierarchical, cascading down through the organization and to key business-process owners. Ownership of the supporting strategies is clearly identified with measures at the appropriate level or process owner within the organization.

Here is a hypothetical sample of a hoshin planning chart for an appliance company attempting to grow its business:



Road Map

Road maps can be presented in as engaging a format as the audience requires, but should be considered working documents subject to change as learning continues. The example shown here is a simple Gantt chart, easy to follow but requiring a lot of detail and definition to be complete. Specifically, detailed objectives, roles and responsibilities, business rationale (business case), and executive focus are needed to ensure success.

Many tools can be employed to clearly identify root causes and create unambiguous, detailed plans for each action on the Road Map. For several examples:

- One of the most effective ways to analyze processes is the 'brown paper' approach, which uses a large, information-rich, low-tech high-touch format to ensure everyone who touches or is touched by a defined and scoped process has the opportunity to provide their insights.
- Effective Rapid Improvement Events (RIEs) are based on the Japanese 'Kaizen' concept, in which a very well planned and professionally facilitated cross-functional team addresses a narrow-scope problem for several days and develops an initial solution which is implemented immediately, to be continuously improved as necessary. The impact is instantaneous, and not only corrects a problem but also builds enthusiasm for continuing improvements.

Activity		***1***	***2***	***3***	***4***	***5***
1	Executive Sponsorship Training					
2	Voice of the Customer Process Development					
3	Process Review					
4	Decision Process RIE					
5	Process "A" Analysis					
6	Department "A" Work Process RIE					
7	Lessons Learned Review					
8	Initial Organization Review					
9	Strategic Direction Workshop					
10	Process Analyses					
11	Department Work Process RIEs					
12	Lessons Learned Review					
13	Organization Design Review					

Case Study – IBM 360

Was IBM just lucky with the '360' General Purpose Business Computer?

Here's an example of how a clear operating vision can foster business success. In the early 1960's, IBM knew what to develop and how to develop it. This can be contrasted with IBM's operating vision of the late 1980's and the fumbled personal computer effort that resulted.

IBM's Operating Vision – 1965

Business Intelligence/ Voice of the Customer	As a large company working with large companies, IBM was able to envision the value of a general purpose computer and test concepts with existing customers
Strategy	IBM strategy was, since the 1920's, to be a dominant player in machines used to manage business, clear to all employees
Financial Management/ Capital Investments	With deep pockets and intelligent review of every significant investment, IBM was long admired for its financial savvy
Organization	IBM had/has a superb organization to develop, produce, and market business machines
Decision Process	IBM's Phase Review process brought the right people and information together in a disciplined, effective way
Executive Sponsorship	Executives were always very involved in the top money-making machine evolution. Tom Watson, Jr. sponsored the 360
Team	IBM has excellent bench strength but also a stable of certified geniuses. Gene Amdahl led 360 development
Marketing & Sales	IBM has always been known for its highly-trained and well-disciplined sales organization
Supply Chain	IBM owned the most critical component makers and managed others with attention in a cooperative manner
Production Capabilities	IBM's production capability was always excellent. Its near-monopolistic high-pricing ensured quality was not an issue
Technology	While IBM had a superb research staff and facilities, it always used proven technologies in products such as the 360

Case Study – IBM Personal Computer

What the heck were they thinking?

Here's an example of how a muddled operating vision can inhibit business success. In the early 1980s, IBM (rather, a small band of upstarts within IBM) decided to see what could be done in the teeny tiny computer arena. In a one year 'skunk works' type project the company created the original PC (Personal Computer, with 16K of memory, an 80 x 25 character green screen, and no hard drive) and the world embraced it with enthusiasm. IBM then struggled with ways to make it a 'real' computer while Bill Gates and a host of hardware imitators built clones and software and ate IBM's lunch, leaving billions on the table. But it is difficult to argue with a large, successful company like IBM. It is likely that vigorously pursuing the PC market would have irreversibly altered the corporate culture and strategy, or at minimum fostered a challenging internal schism.

IBM's Operating Vision – 1982

Business Intelligence/ Voice of the Customer	As a large company working with large companies, IBM had trouble envisioning a way to make money selling consumer products.
Strategy	IBM strategy hasn't changed: dominate business machines
Financial Management/ Capital Investments	With deep pockets and intelligent review of every significant investment, IBM was still admired for its financial savvy
Organization	IBM had/has a superb organization to develop, produce, and market business machines. But they were high-end bigots.
Decision Process	IBM's Phase Review process brought the right people and information together in a disciplined, effective way
Executive Sponsorship	A splinter group of mavericks created the PC
Team	IBM has excellent bench strength on the HIGH END
Marketing & Sales	IBM has always been known for its highly-trained and well-disciplined high end sales organization
Supply Chain	IBM owned the most critical component makers and managed others with attention in a cooperative manner
Production Capabilities	IBM's production capability wasn't designed to compete with consumer product companies
Technology	While IBM had a superb research staff and facilities, it used proven technologies in the original PCs

Vision: Closing Comments

In Chapter 1 we have demonstrated a straightforward framework for addressing business problems, including more complex cross-functional and cultural problems that may have evolved over the course of years. If it seems simplistic, consider that organizations require simple and clear visions and road maps to successfully operate and continuously improve. This is critical both to the executive team, needing a context for prioritization, and the workforce, needing clear guidance and direction from their executives.

Clearly greater detail - closer to where the rubber meets the road - is required to actually resolve a given problem. The process mapping and the Rapid Improvement Event chapters suggest ways to gain the depth required to resolve many operating problems. Many other tools and techniques are available, including the excellent tools of traditional ‘Six Sigma’ black belts as well as the culture-changing tools of lean leaders. However you elect to approach a business problem, it is important to start with a robust and reliable framework for understanding your business.

NOTES:

Lean toward Lean

Lean Operations

An important recent framework for analysis and decision-making is that of a lean operation, focused simultaneously on:

- Decreasing Waste, Cost and Cycle Time
- Increasing Capacity Potential
- Increasing Quality
- Low Absenteeism/voluntary Turnover
- Extensive Measurement of Key Processes
- High Levels of Worker Involvement,

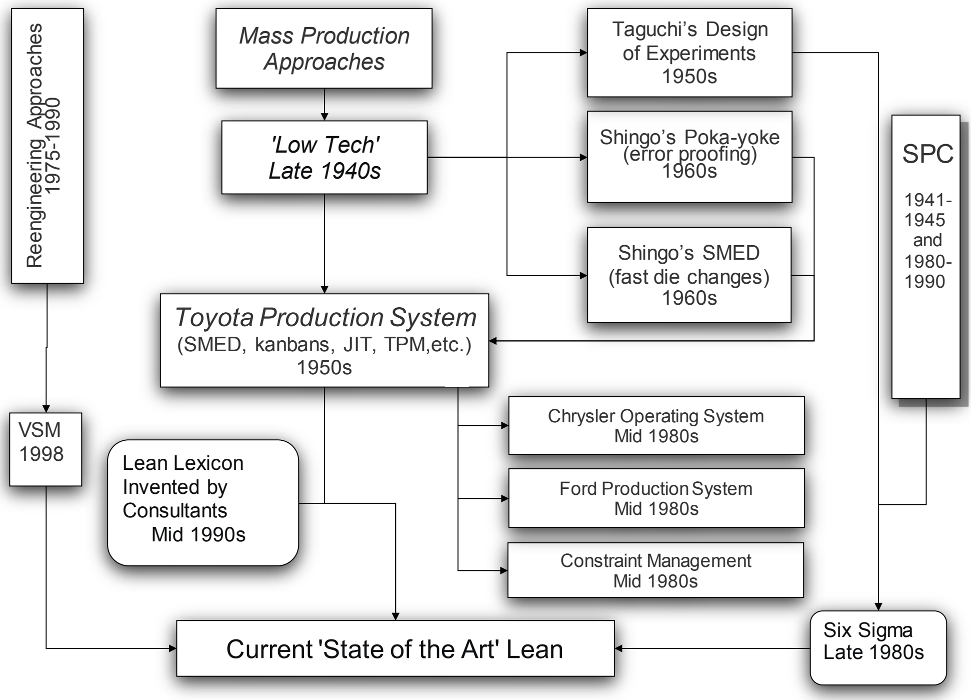
> Elevator Pitch
>
> "The 'Lean' philosophy focuses on the relentless elimination of waste based on a 'pull' production system."

All of these benefits, and the ability to sustain them, are derived from the disciplined application of common sense tools and techniques that have been developed and refined in the manufacturing environment since the early 20th Century (see the chart on the next page for some of the heritage). For most traditional organizations lean requires a significant culture change, with executives and managers directly involved and floor personnel empower trained for continuous improvement.

Recently, the 'mass production' of transactions, documents, paper instruments, and records has created the need for lean operations in the clerical world ('Lean Office'), where higher quality translates into both operating efficiency and (often more importantly) improved effectiveness with highly leveraged benefits.

While producers have focused on efficiency since the earliest records were kept (see the Evolution of Lean graphic on the next page), Japanese terms are widely-used in discussions of lean because these common-sense concepts were initially adopted into their current effective, disciplined form by Japanese manufacturers.

The Evolution of Lean



Why Lean is Important

Lean is the right approach to all repetitive activities in all organizations regardless of the goods or services they provide, because:

- Global competition is heating up as the Internet flattens the world
- Customers want fewer suppliers, better product quality, and delivery reliability
- Customers want custom products at mass-produced prices
- Markets are price and value driven – costs are irrelevant to customers
- There is significant overcapacity in all significant markets
- Quality standards are very high, and rising, everywhere

- Technology is universal and does not offer anyone more than a temporary edge
- Investment money follows yields across industries – competition is unrelenting

Lean helps address these challenges by:

- Designing capacity to meet demand, eliminating most excess capacity
- Minimizing response time at the product, service and customer interface
- Minimizing reaction time to problems
- Minimizing assets (especially all types of inventory)
- Minimizing delays (materials and products)
- Maximizing flexibility
- Maximizing throughput speed / minimizing throughput time

Resistance to Lean

Humans have never gravitated to organizing disciplines, and as work complexity increased in the industrial age the tendency has been to work in a rote manner based on engineering-type solutions with spurious precision. Few people really like to change, often through fear of wandering from the ‘engineered’ path into uncharted territory, and creating a lean team and a new culture often involves serious, fundamental change. When this is done poorly, failure to achieve lean reinforces existing weak practices and resistance to change increases.

Lean Tools and Concepts

Lean employs an impressive, sophisticated kit of concepts, tools and techniques, many of them complex enough to merit detailed explanation. This text deals with some of the key tools of lean in a sequence appropriate for a training class, beginning with foundational concepts.

<table>
<tr><td colspan="2">Focus on Reality</td></tr>
<tr><td colspan="2">Value Stream Mapping</td></tr>
<tr><td>Chaku-Chaku</td><td>TPM</td></tr>
<tr><td rowspan="2">Shift Huddles
Area Display</td><td>SMED</td></tr>
<tr><td rowspan="2">Constraint
Management</td></tr>
<tr><td rowspan="2">Visual
Workplace</td></tr>
<tr><td>Kanban</td></tr>
<tr><td>Poke-Yoka</td><td rowspan="2">One-by-One
Production</td></tr>
<tr><td>5S</td></tr>
<tr><td>Waste
Identification</td><td>Pull System</td></tr>
</table>

In addition to these, lean employs tools shared with Six Sigma to identify, analyze, and correct processes that drive inefficiency, addressed in Chapter 4.

Lean Accounting

Lean Accounting focuses the business on the elimination of wasteful spending by aligning the financial measurement system with the value stream. Rather than continuously updating the costs of parts in WIP, this approach estimates the cost of finished products by combining all of the costs incurred in the value stream and dividing by the output for each accounting period. Since inventory is minimized and stabilized in the lean plant, the wasteful work of complex cost accounting is eliminated.

Often the first impact of lean accounting is DEGRADED cost performance, as excess inventories are eliminated and their costs are realized, but once in full effect the method frees up accountants to focus with lean teams on cost drivers that can be improved.

> <u>Elevator Pitch</u>
>
> "Standard cost accounting typically focuses on valuing inventory at all stages of production, and on keeping expensive machinery in production. Lean accounting instead focuses on value created in the overall value stream, and in optimizing the inventory even if key machines are occasionally idle."

Types of Waste ('Muda')

Elevator Pitch

"Lists of typical types of office and manufacturing waste can act as checklists for identifying the most common causes."

'Muda' (Japanese for 'waste') is everywhere. Since lean as a defined program started in the manufacturing environment (especially the Toyota Production System), many of the tools of lean refer to manufacturing type wastes. However, the principles apply equally well to the office, where 'production' might refer to a stream of transactions and 'inventory' might be a backlog of transactions. In the production facility, waste can mean the inefficiency of waiting for materials and the more expensive waste of producing out-of-spec product. Analogously, in the office, waiting for transactions is inefficient but doing them wrong can be disastrous.

Two other terms are used in the Toyota Production System to describe waste:

- 'Mura' (Japanese for 'unevenness') referring to disjointed production flow and addressed by Just-In—Time systems, line balancing, and kanbans

- 'Muri' (Japanese for 'by force') referring to the force-fitting of out-of-spec parts and addressed by standardized parts made with standardized processes

There are many types of waste to address. The chart on the next page illustrates a few 'usual suspects' to seek out in typical organizations. [1]

Production Waste

Source	How it Happens	Possible Root Causes
People & Equipment	Processing inefficiently	Process design, tools, skills, attitudes
	Excessive motion	Plant layout, moving devices
	Waiting	Process design, line imbalances
	Goal Alignment	Leadership, supervision
Quality	Scrap and rework	Processes, metrics, people
Inventory	Excessive Raw Materials	Supply chain issues
	Excessive WIP	Process design, poor or no kanbans
	Excessive Finished Goods	Marketing or transportation issues

Office Waste

Source	How it Happens	Possible Root Causes
People & Office Machines	Resources	Hiring, training
	Reporting	Organization structure, politics
	Processing inefficiently	Process design, tools, skills, attitudes
	Excessive motion	Workplace layout, moving devices
	Waiting	Process design, line imbalances
	Goal Alignment	Leadership, supervision
Team	Composition	Required skills availability
	Structure	Leadership, management
	Focus	Scope, culture, problem definition
	Conflict	Office politics, personalities
	Work Area	Size, layout, equipment
Process	Work boundaries	Roles & responsibilities, politics
	Sub-optimization	Process design, politics
	Lack of standardization	Process design, management
	Performance	Metrics, leadership
Tools & Technology	Capacity	Design, process evolution
	Integration	Cost, complexity
	Knowledge	Ease of use, skill requirements

Pull Philosophy

> **Elevator Pitch**
> "Pull systems attempt to produce goods only when needed and bring them to where they are needed."

The fundamental principle of lean production is a pull system. In a perfect pull system, nothing would be produced until it was demanded by a paying customer, in contrast to push systems in which products are pushed through manufacturing onto shelves where they wait for customers.

In that perfect pull system, a customer purchase would create a signal to the store, then to the warehouse, then to the manufacturer, then to the suppliers of parts, all the way back to the raw materials producers, and nobody would make anything until the customer acted. There would be no inventories of any kind except those actually being worked on or transported to the customer, and financial systems would not be designed to maximize machine utilization but to maximize the profit of the value chain.

Of course, there cannot be a perfect system. 'Monuments' – machines that touch every product – and other bottlenecks, along with unbalanced production capacity and physical distances to customers, require lead times for raw materials, parts, labor scheduling, and transportation, which in turn requires appropriate inventories along the value chain. These appropriate inventories are called ‘kanbans,’ described later.

Manufacturing Resource Planning (MRP) systems traditionally support push systems, attempting to place the right inventory in a factory in the right place at the right time to optimize production efficiency. While strong technology can also be used to support pull systems, attempting to ensure each station has just what it needs for production with no excess, a pull system is not dependent on technology for its success. It can be as low tech as a system of lights that are turned on or flags that go up when inventory reaches the prescribed kanban replenishment level, signaling for production at the next preceding stage. An effective pull system is primarily dependent on the people who operate it, using common sense and lean tools and techniques to continuously attack waste in the production process.

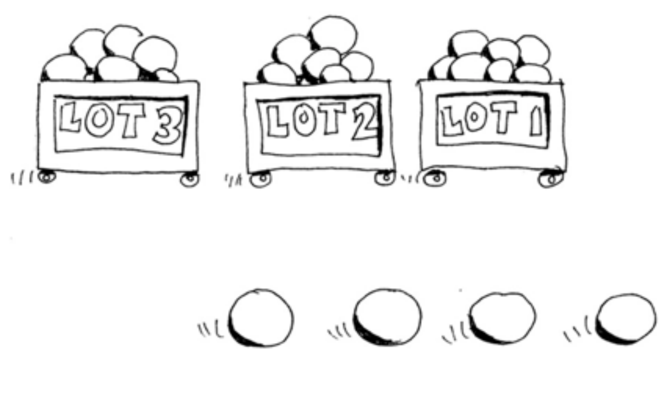
One by One Production

> **Elevator Pitch**
> "One by one production is an ideal seldom attainable. The practical goal is to reduce batch size to the minimum, trading off batch run efficiencies for minimum inventory."

In One by One Production (Single Piece Flow), products proceed one at a time through production. Ideally, there would be no interruptions, scrap or batch inventories anywhere on the line, and all materials would be work in process or finished goods on their way to a customer.

For example, in One by One Production, if a part moves through 3 one-minute steps it is ready after 3 minutes. In a batch of 100 pieces, it would have taken 300 minutes - 5 hours of inventory, and 5 hours any time the line needs to be restarted. Presumably the operators would stagger the batches to manage the work, but planning for this, and storing and moving the batches, will likely add work and space requirements that could be eliminated employing a batch size of one.

As a general rule, the smaller the batch size the better. However, optimization of batch sizes needs to consider the machinery and layout of the production area. Some inefficiency inherent in larger batch sizes might be offset by efficiencies in batch processing (e.g., equipment set up per unit may be reduced).

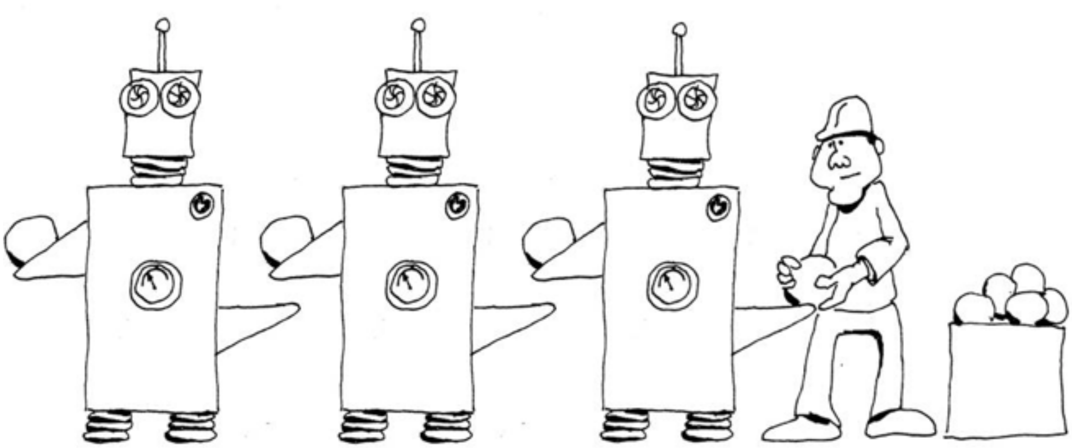


Chaku-Chaku

> **Elevator Pitch**
> "Chaku-chaku is a production approach that automates a sequence of steps from machine to machine, minimizing the opportunity for human error."

'Chaku-Chaku' is Japanese for 'Load-Load.' A 'chaku-chaku' line integrates humans and machines ('autonomation') to perform steps in a production process. The human operator loads the first machine, which automatically offloads to the next machine (using 'hanedashi' devices) when its production step is completed, and so on until human intervention is again needed; humans might be primarily overseers all the way to final assembly or shipping. By optimizing the machinery and its controls, the plant can approach a true one-by-one production system, with rapid adjustment of Takt time as demand changes, and quality may be better built into a line that minimizes human error.

If a chaku-chaku line begins to produce out-of-spec parts, operators are entrusted with the authority to stop the line instantly, and machines are designed to recognize abnormalities and automatically stop production as well ('jidoka').



Constraint Management

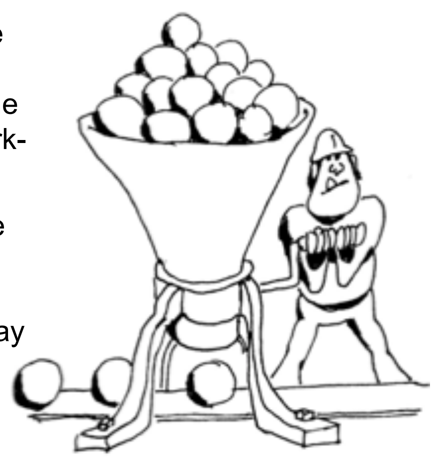
> **Elevator Pitch**
>
> "Every production line has a 'drum' – a process that constrains and sets the pace for the whole factory."

Every operation has a key constraint or bottleneck that limits output, thereby limiting the main goal of the operation (usually profitability in commercial enterprises). This constraint is a work process or key machine ('monument') through which every product must pass. The Theory of Constraints (TOC) aims to improve the flow (and throughput), pulling (rather than pushing) materials through the operation by focusing on the 'Drum,' the 'Buffer,' and the 'Rope' (DBR).[2]

The 'Drum' is the physical constraint of the plant, the work center or machine or operation that limits the ability of the entire operation to produce more. The rest of the plant follows the beat of the drum. Operators make sure the drum is always working and that the drum's output is fully utilized.

The 'Buffer' is inventory that protects the drum, so that it always has work flowing to it. Buffers are measured in time increments rather than quantity of material, setting priorities based on the time an order is expected to be at the 'Drum.' Buffers are maintained as raw or WIP inventory at the 'Drum' and at various synchronization points, and as finished goods ready for shipping.

The 'Rope' is the work release mechanism for the plant. An order is released into the plant only one 'buffer period' before It is due. Pulling work into the system earlier than a buffer time creates high work-in-process and slows down the entire system.



Eliminating the constraint at the 'Drum' moves the constraint to another part of the operation, which might be the next improvement target in a never-ending process. But this improvement process may require investments in labor or equipment, and must be weighed in light of the demand pulling product through the operation. The constraint will be irrelevant if there is insufficient demand to utilize the increased capacity. Business cases analyses may be required.

The Theory of Constraints considers four production flow designs to identify areas for improvement:

- I-Plant: Material flows in a sequence, such as in an assembly line. The primary work is done in a straight sequence of events. The constraint is the slowest operation.
- A-Plant: The general flow of material is many-to-one, such as in a plant where many sub-assemblies converge for a final assembly. The primary problem in A-plants is in synchronizing the converging lines so that each supplies the final assembly point at the right time.
- V-Plant: The general flow of material is one-to-many, such as a plant that takes one raw material and can make many final products. Classic examples are meat rendering plants or a steel manufacturer. The primary problem in V-plants is "stealing" where one operation (A) at a diverging point "steals" materials from the other (B). Once it has processed through A, it cannot come back and run through B without significant rework.
- T-Plant: The general flow is that of an I (or multiple lines), which then split into many assemblies. Most manufactured parts are used in multiple assemblies and nearly all assemblies use multiple parts. Customized devices, such as computers, are good examples. T-plants suffer from both synchronization problems of A-plants (parts aren't all available for an assembly) and the stealing problems of V-plants (one assembly steals parts that could have been used in another).

Step-by-Step [3]

1. Articulate the goal (e.g., "Make more money").
2. Identify the constraint (what prevents the organization from achieving the goal?)
3. Decide how to exploit the constraint (make sure the constraint is doing things that it uniquely does, and not doing things that it should not do)
4. Subordinate all other processes to above decision (align all other processes to the decision made above)
5. Elevate the constraint (if required, permanently increase capacity of the constraint; 'buy more')
6. If, as a result of these steps, the constraint has moved, return to Step 1. Don't let inertia become the constraint.

Throughput

Elevator Pitch

"Increasing throughput only helps if there is unmet demand, or if improved efficiency can be applied to reduce resources."

'Throughput' refers to the amount of product coming off the assembly line (or paperwork system). It can be increased by removing constraints, by applying more human or machine resources, or improved processes, methods, or procedures. Investments in removing constraints only help if there is demand for more product or if the constraint is causing inefficiency in the system, and measuring the benefits even then is a little complex. Before launching an effort to improve throughput, It is useful to understand the value, and the throughput / yield evaluation tool on the available CD can help.

Yield

The term ‘yield’ refers to the percentage of good product coming out of an operation compared to the input resources. An example is the manufacture of computer chips, where a large wafer with multiple chips is produced but some of the chips will not pass inspection and are scrapped. In a multi-step operation, the yield of each step factors into the final output. For example, if each of 5 steps yields 90% good product, the overall yield is .90 x .90 x .90 x .90 x .90, or about 59%.

> Elevator Pitch
> “Improving yield (good products per resources invested) gains more bang for the buck by definition. The only consideration is the investment required.”

While improving throughput may not secure much benefit, depending on the demand drivers and operating inefficiencies, improving the yield of an operation is always a good way to reduce waste. But whereas lean tools generally apply more directly to the throughput problems, the sharp statistical tools of Six Sigma are generally required to improve yields.

Before launching an effort to improve yield It is useful to understand the value, and the throughput / yield evaluation tool on the available CD can help.

Focus on Reality

<u>Elevator Pitch</u>

"Problems are most effectively and efficiently eliminated by focusing the real work crew on the real parts in the real location using personally observed real facts."

The Toyota Production System espouses the philosophy that, in order to fix a problem, the people who are actually involved in the process creating the problem need to focus on the real products or parts that are being made ('gembutsu'), in the real part of the line where they are being made ('gemba'), based on the real facts of the situation ('genjitsu'), relying on personal observation ('genchi genbutsu').

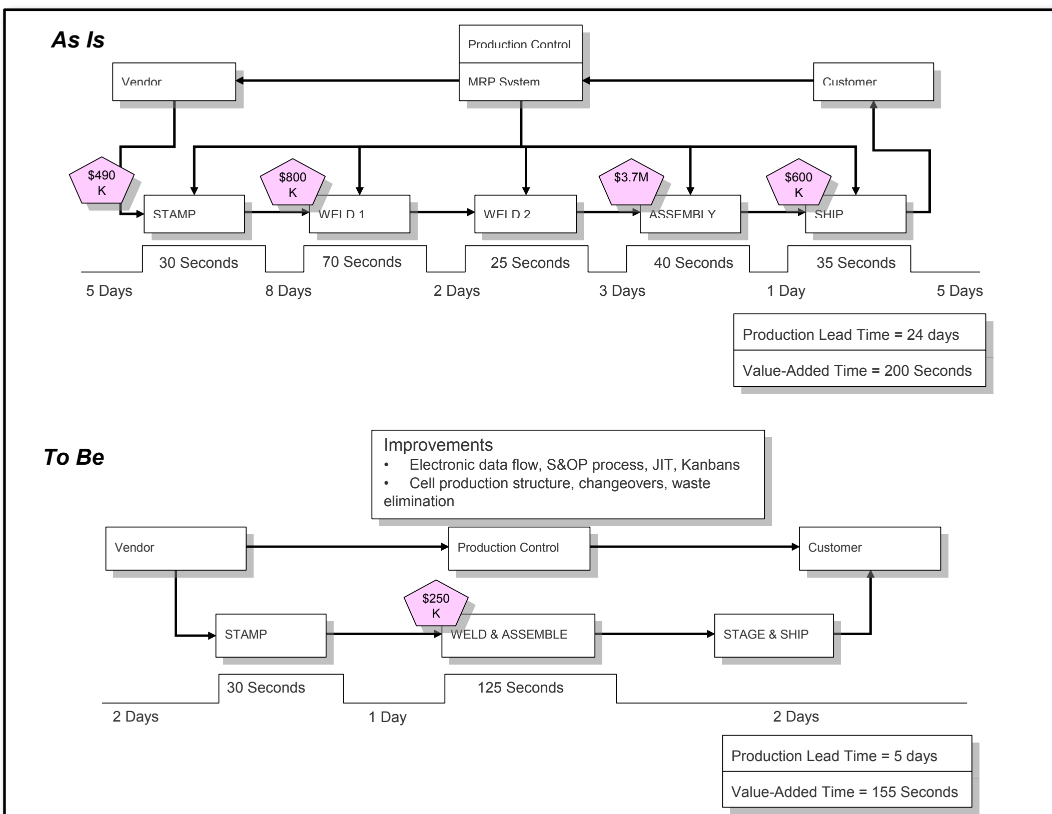
In complex production processes, there is benefit in having industrial engineers design a production line and its steps. But to be lean, they must resolve problems and constraints with the real humans who will do the real work.

Value Stream Maps

A fundamental insight of lean is that improvement efforts focus on each product and its value stream rather than the organization, its assets and technologies. A value stream map displays all of the steps required to deliver a product from raw material to customer delivery, and focuses especially on barriers to a smooth and timely flow.

<u>Elevator Pitch</u>

"The concept of a Value Stream – how a company creates value – focuses improvement efforts on the processes that create products rather than the organization or assets required."



Step-by-Step

1. Assemble materials (such as a large inexpensive sheet of paper, tape, glue, markers, etc.)
2. Assemble a team that understands the processes
3. Define the scope
4. Define the process steps and sequence them on the paper from raw materials to finished products
5. Determine the actual process time for each step
6. Determine how much inventory exists at each step
7. Calculate 'turns' to determine how long inventory waits in each location
8. Review the map with the experts to identify improvement opportunities
9. Sketch out a possible 'to be' map with the experts
10. Iterate until a recommended map is generated

The total value stream might include a complex set of companies and plants, so It is useful to start with those activities bounded by the process owner ('door-to-door' within a plant, for example). This keeps the project at a manageable level of complexity but retains a sufficient 'big-picture' scope, required to avoid selective implementation resulting in isolated islands of improvement within a flawed process.

In the example shown on page 43, the 'As Is' and 'To Be' maps for a hypothetical organization are displayed to provide a sense of how improvements can be conceptualized. The wait and production times are captured at the bottom of each chart and inventories (in the shaded pentagons) are shown where they accrue, for easy visualization.

The value stream concept is of great interest to a process improvement team because it highlights wasted time, resources, and energy. It is also the starting point for defining a lean accounting system, helping the financial team simplify and significantly improve cost information. Lean accounting is beyond the scope of this chapter but information is available in the ROI-Team website library and from numerous other sources.

Visual Workplace

In the 'visual workplace' an uninstructed visitor can easily figure out what is happening. Floor traffic lanes are clearly marked, 'Area Goals & Metrics Boards' describe work area activities and performance, tool and part racks are color-coded, and prominent signs ensure safety and efficiency everywhere. It would take uncommon inattention to make errors.

The visual workplace relies on excellent signage, with colors and icons that consistently reinforce common sense activities and material movements. Note the links to kanbans and the pull environment, where visual cues ensure that the correct material is called for in the correct quantity at the correct place. Lean production cannot be practiced effectively in a non-visual workplace.

<u>Elevator Pitch</u>

"Visual cues can make it dramatically easier for workers to maintain a safe, efficient workplace."

<u>Step-by-Step</u>

For each target process area:

1. Identify any worker issues that might arise from confusion, misplaced parts, etc.
2. Have informed visitors from a different department walk through the operation in question, taking notes on anything they don't understand
3. Assemble a team from the target area, plus others with visual workplace experience, if available
4. Use the issues and comments as a starting point and brainstorm what visual cues would contribute to safety, quality, and efficiency

Line Balancing

Elevator Pitch

"A production line is balanced when each process step takes about the same amount of time, and less than Takt time."

Takt Time

$$\frac{\text{Total time available}}{\text{Required units produced}}$$

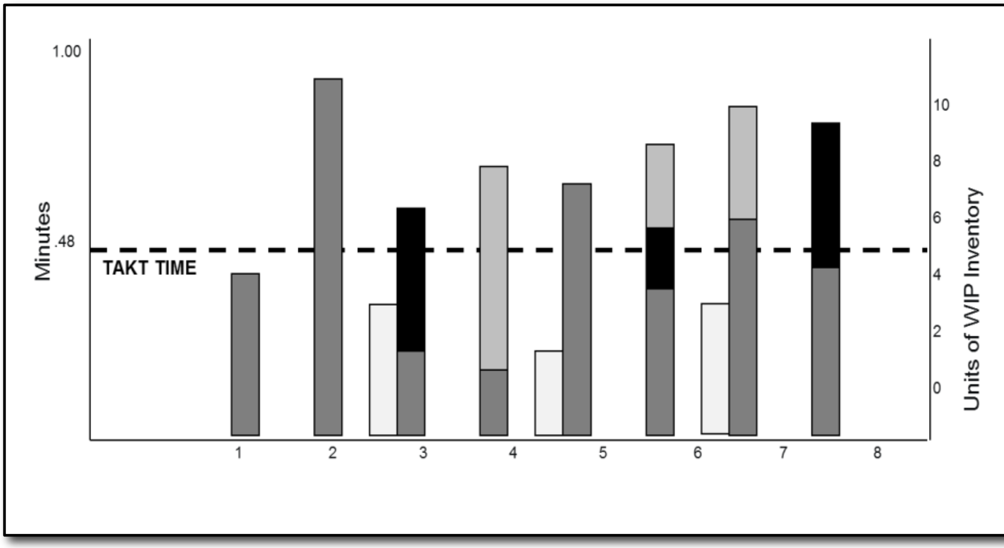
For example,

$$\frac{480\text{ min}}{1{,}000\text{ units}} = 0.48\text{ min}$$

From the German word Taktzeit ("cycle time")

In a balanced production process, each step requires about as much time as other steps, as close to Takt time (the 'beat' at which finished units cross the finish line) as possible. For example, in building cars, 4 wheels need to be mounted at the same rate as 1 hood, 6 windows, 4 seats, and 1 steering wheel. Lean requires that steps in a production process be as balanced as possible, avoiding the wastes of inventory buildup, walking, and waiting

Here, several of the production steps exceed Takt time, and none are perfectly aligned. Workers are walking and waiting at some stations while inventory piles up at others.



Some possible solutions to this imbalance include:

- Work assignments: more workers might be required at station 2; stations 1 and 2 might be combined; and / or cross training might balance work among stations 2, 3 and 4.
- Workplace layout (a 'spaghetti chart' would help in this analysis): station 4 might be moved closer to station 5; a conveyor might be installed; the productive work time might also be improved using better tool and part layouts in a more 'visual' environment.

The solution is dependent on the nature of each task and on the size and complexity of equipment, of course, and perfection is unlikely, but the work team can often improve such an out-of-balance condition using low-tech (and low-cost) solutions.

Standardized Work

Elevator Pitch

"Work standardization helps ensure processes (and results) are consistent."

Standardized work describes an individual worker's job as a series of defined steps, producing specific WIP quantities in as close to Takt time as possible. Its constraints are safety, quality and customer satisfaction, schedule, and cost. In lean operations, work stations are designed for efficiency and kanbans are defined to control the WIP movement; step-by-step standardized work becomes easy to define in this orderly environment. Here is a typical Standard Work Sheet, used to analyze a task or set of tasks.

Process Description	Time				Cumulative Time (sec)								
	Walk	Work	Auto	Wait	10	20	30	40	50	60	70	80	90
1. Position wotk piece		10											
2. Drill 3 holes	5		5	5									
3. Reposition work piece		15											
4. Cut off excess length	10	10											
5. Reposition work piece		10											
6. File holes clean		5											
7. Prep for painting		15											
8. Position on cart		5											
TOTAL	15	70	5	5									

Working
Walking

Takt time = 45 Seconds

In the example illustrated on page 48, the job requires more than Takt time. To resolve this, consider –

- Could the work piece be positioned faster with better jigs and fixtures?
- Could the equipment be positioned on the same table to reduce walk time?
- Could the operator do something productive while holes are being drilled automatically?
- Will additional workstations eventually be required to meet Takt time?

Step-by-Step

1. Define the starting and ending points (scope) of the task at hand
2. Establish exactly what happens to the work piece sequentially. This may be a challenge for the initial analysis, because different workers may do it differently (and the same person may do it differently from one time to the next)
3. Time each step: Because of variances in approach, times may vary radically. Develop a representative set of times, with worker involvement
4. Show the cumulative time graphically. Color code the work time, walk time, and automated time to facilitate analysis.
5. Analyze for opportunities

5S Principles

Elevator Pitch

"Lean production with Six Sigma quality is not possible in a disorganized, dirty workplace. In a lean audit, the 5S exercise is a very good starting point."

Step-by-Step

1. Use the checklist in this book or on the available CD-ROM (as is or adapted to your work environment) to create a 5S spider diagram for your organization.
2. On the checklist, enter the number 1 to 5 in the Rank column, to indicate

   1: Very Poor
   2: Poor
   3: Fair
   4: Good
   5: Outstanding

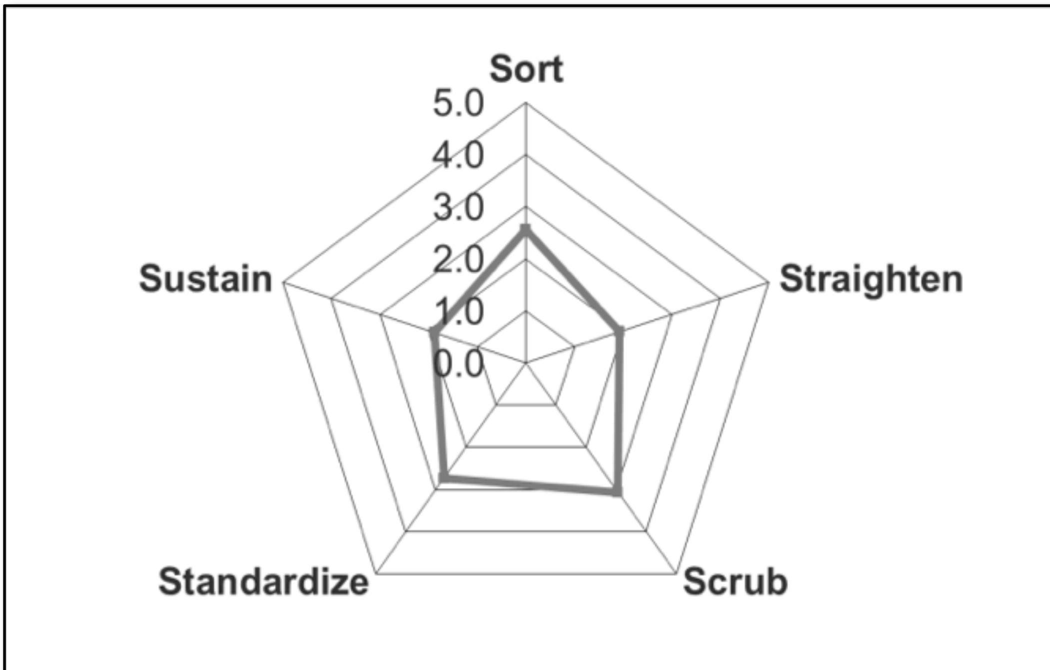
3. You can use or modify the audit checklist provided.

'5S' refers to the principle of waste elimination through workplace organization. The concept is derived from the Japanese words seiri, seiton, seiso, seiketsu, and shitsuke, with English counterparts:

1. Sort (separate needed tools, parts, and instruction from unneeded materials and to remove the latter)
2. Straighten or simplify (neatly arrange and identify parts and tools for ease of use)
3. Sweep or scrub (conduct a cleanup campaign)
4. Standardize (sort, simplify, and scrub at frequent intervals to maintain a workplace in perfect condition)
5. Self-discipline or sustain (form the habit of always following the first 4 'S' elements).

It is obvious that an orderly workplace is critical to lean operations, which rely on visual simplicity to keep parts flowing in response to pull signals. Safety is also improved in a clean and orderly environment, and an added benefit in many operations is that foreign matter is kept out of the products, with a direct quality impact.

The following chart shows the results of a typical 5S audit, using dummy data from the checklist on the next page. When all of these indicators fall in the ‘good’ or ‘outstanding’ blocks, workers spend very little time looking for things or working around spills and clutter.



5S Audit Checklist

1. Sort		Rank
1	Inventory where it belongs	
2	Scrap / rework where it belongs	
3	Transit equipment well-maintained	
4	No unnecessary items / tools / paperwork in work area	
5	Posted notices appropriate and up-to-date	
6	Nothing on top of equipment or lockers	
7	Correct equipment labels	
2. Straighten		
1	Production flow direction and method well marked	
2	Aisles, power panels, and emergency equipment clear and accessible	
3	Equipment, tools, measuring devices, and supplies neat and convenient to operations	
4	Work area tools location identified, tracking system in place	
5	Pipes and wires in good repair, color coded with directions indicated as necessary	
6	Clear circuit diagrams / switch markings for electrical and fluid panels	
7	All items stored in work area clearly identified	
8	Moving equipment properly located	
9	Documents neatly stored in identified locations, ownership identified	
10	Desks neat and well organized	
11	Bulletin boards well maintalned	
3. Scrub		
1	Wires and pipes connected neatly and safely to equipment	
2	Equipment, wires, and pipes protected and free of dirt, oil, rust, hydraulic fluid	
3	No equipment / pipe leaks	
4	Storage locations clean and orderly	
5	Power panels secured properly and safely	
6	Measurement equipment well cared for	
7	Gauges and indicator lights clean and easy to read	
8	Moving equipment well maintained	
9	Floor / aisles markings clear and intuitive	
10	Floors and walls clean and clear of dirt, oil, grease, hydraulic fluid, and trash	
11	Floor, wall, equipment, and pipe paint in good condition	
12	Benches and desks clean, orderly, and free of trash	
4. Standardize		
1	All hazards clearly identified	
2	Equipment controls clearly and correctly labelled	
3	Valves and switches clearly marked (on / off, open / shut, direction)	
4	Power / pressure meter ranges clearly marked	
5	Equipment status indicators in good working order	
6	Fan belts, chains, pulleys covered with size / capacity labels affixed	
7	Critical maintenance requirements and responsibilities clearly identified	
8	Equipment maintenance sheets current, clean, and neatly displayed	
9	5S status displayed and responsibilities identified and known by all workers	
5. Sustain		
1	Performance tracking visible and current - daily, weekly, monthly as appropriate	
2	Attendance and skills availability visible and current	
3	Continuous improvement / kaizen tracking visible and current	
4	Workgroup 5S audit score visible and current	

Total Productive Maintenance (TPM)

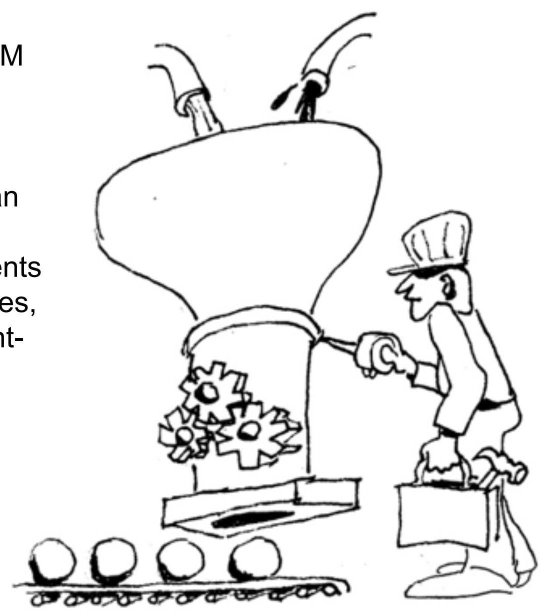
It is impossible to maintain an effective production schedule, and a lean operation, with random unscheduled interruptions. Total Productive Maintenance (TPM) is a disciplined approach to scheduled maintenance with an objective to gain optimum run time from every significant machine. Maintenance schedules are integrated with production schedules and rigorously enforced.

Preventive maintenance concepts (for example, knowing Mean Time to Failure (MTF) for significant machines, and planning maintenance accordingly), critical parts stocking, and shift maintenance resourcing are all keys to an effective TPM program.

One common approach is to schedule all planned maintenance off shift (in less than 24 hour operations) or during holidays or vacations. Others might feature investments in inventory build ahead or spare machines, parts, or assemblies. As in any equipment-dependent process, the quality of the maintenance team is key.

Elevator Pitch

"TPM (Total Productive Maintenance) merges the preventive maintenance schedule into the production schedule to minimize planned and unplanned down time."



Poka-Yoke [4]

> **Elevator Pitch**
>
> "Poka-yoke is applied to methods, equipment, systems, and processes to make errors difficult or impossible to make. For example, stamping presses generally have safety gates and two-hand operating triggers to keep operators from reaching into a closing press."

Poka-yoke ('POH-kah YOH-keh') means 'fail-safing,' 'error-proofing,' or 'mistake-proofing,' and is a fundamental lean concept because it avoids two types of waste:

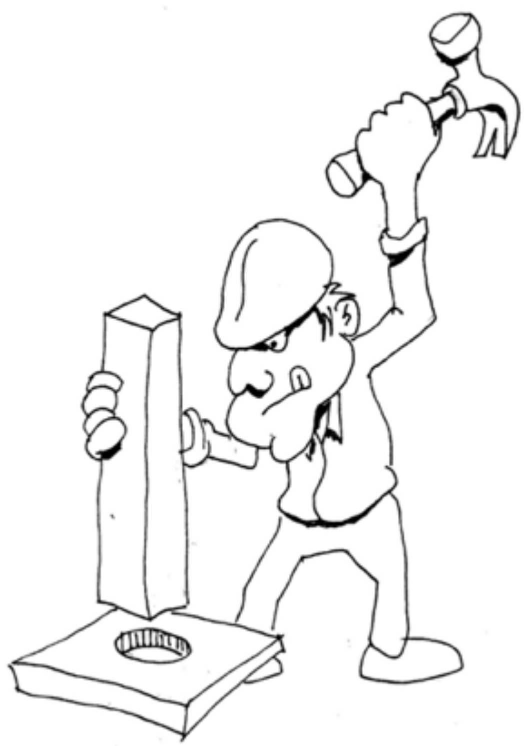
1. Repeatedly investing time in figuring out the right way to do something, and
2. Doing things erroneously, requiring rework or creating scrap.

The term means avoiding (yokeru) inadvertent errors (poka). It is a behavior-shaping constraint, or a method of preventing errors by putting limits on how an operation can be performed in order to force the correct completion of the operation. The concept was originated by Shigeo Shingo as part of the Toyota Production System. Originally described as Baka-yoke ('fool-proofing' or 'idiot proofing'), the name was changed to the milder Poka-yoke. One example is the inability to remove a car key from the ignition switch of an automobile if the automatic transmission is not first put in the 'Park' position, so that the driver cannot leave the car in an unsafe parking condition where the wheels are not locked against movement.

Shigeo Shingo recognizes three types of Poka-Yoke:

1. The contact method identifies defects by whether or not contact is established between the device and the product. Color detection and other product property techniques are considered extensions of this.
2. The fixed-value method determines whether a given number of movements have been made.
3. The motion-step method determines whether the prescribed steps or motions of the process have been followed.

Poka-yoke either give warnings or can prevent, or control, the wrong action. It is suggested that the choice between these two should be made based on the behaviors in the process, occasional errors may warrant warnings whereas frequent errors, or those impossible to correct, may warrant a control poka-yoke.



Kanbans

Elevator Pitch

"Kanban means 'storefront' and refers to the practice of treating production centers as standalone store-like demand centers, to pull inventory through a production process."

Step-by-Step

1. Kanbans are regularly updated as demand rises and falls
2. individual kanbans are calculated based on a number of factors, such as:
   - Flow rates set by throughput
   - Lot sizes upstream
   - Safety stock requirements
3. Visual signs are updated as kanbans are revised, and operators are informed

'Kanban' means 'store front' in Japanese, and refers to the shelf-stocking practices of supermarkets. In that pull environment, it is obvious when product supply is dwindling, and replenishment is automated according to rules that will maximize sales. In the manufacturing environment, the same principle can be applied, though it may require more inventory planning and supporting factory design to make replenishment points visually obvious.

Properly operated, the kanban system will tell much more than simply what amount of parts or subassemblies to stock. If stocks run out, the visual cues immediately highlight upstream problem areas. If stocks pile up, they highlight downstream problems. No data collection, analysis, or decision-making is needed to comprehend and focus on the problem.

Kanbans can be applied to work-in-process, buffer stocks, and transportation or warehouse stocks, following a few simple rules:

- Nothing moves without a kanban.
- Creation of kanbans is strictly controlled, usually by Production Control.
- The number of kanbans is strictly controlled, and continuously reduced.

Kanbans can be in bins, on trucks or forklifts or workbenches, or on a marked floor area, and need to be clearly identified for instant visual tracking. The illustration here is of a typical identification system that marks a kanban area as well as racks of parts as they progress through an assembly operation.

Note how difficult it would be to computerize a kanban, continuously entering minute movements (including a few errors) and trying to follow part progress,

Single Minute Exchange of Die (SMED)

Elevator Pitch

"SMED, or Single Minute Exchange of Die, refers to a disciplined approach to reducing machine setup time to the absolute minimum to support optimum operating flexibility and machine run time."

Step-by-Step

1. Record every step of the changeover process
2. Identify "Internal" and "External" steps
3. Reorder steps to ensure that no "External" actions are occurring while the machine is off
4. Create checklists and procedures to ensure everything is in place before the machine is turned off
5. Examine every "Internal" step for improvement
6. Observe and enhance operator effectiveness

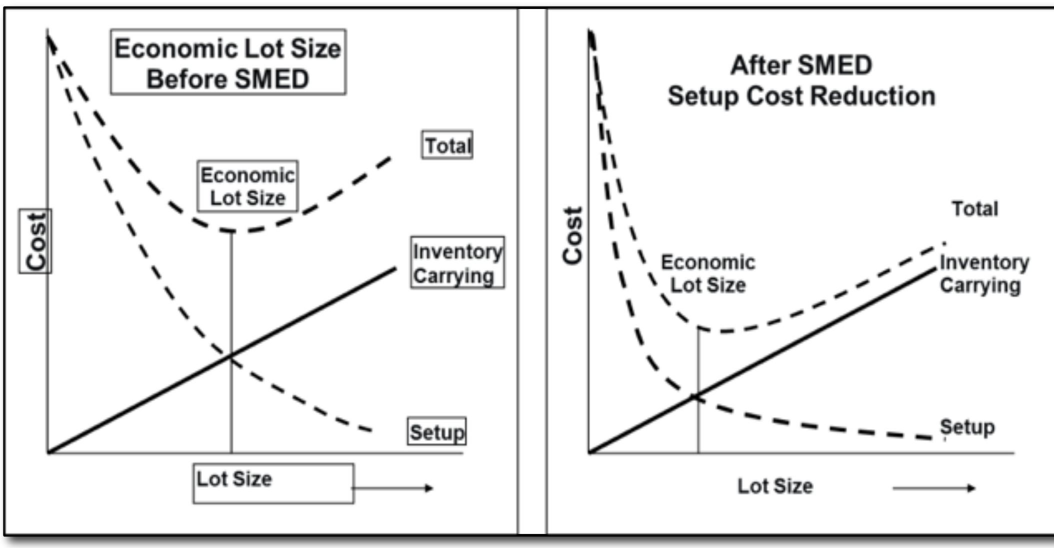
Single Minute Exchange of Die (SMED) is a concept developed by Shigeo Shingo (of Poka-Yoke fame) to systematically reduce the changeover time (time to switch drills, cutters, dies, punches, and the like) required to set up equipment for production runs. The primary goal of SMED is to reduce lead time, for more agile market response and a host of related benefits. In addition, reduced set up times allow the reduction of batch sizes (see One-by-One Production) thereby reducing WIP inventories and associated inventory handling.

In reducing set up times, each step of the setup is identified as

- 'Internal' (the machine MUST be off during this step, as when parts are actually being removed) and
- 'External' (these should NEVER be done while the machine is off. For example, the setup person should not be looking for the new die while the machine sits idle).

'Internal' steps might be improved with machine modifications such as new fixtures or centering marks, or with visual workplace enhancements (tools well organized at the workplace, color-coded parts carts) and training. 'External' step improvements could

The illustration below shows how SMED supports a more efficient trade off of WIP carrying versus set up cost. Large lot sizes drive up the cost per unit of carrying inventory linearly (each unit is carried for a longer period) while the set up cost per unit decreases, as depicted in the 'Before SMED' cost curve. Reducing the set up cost reduces the economic lot size, defined as the point at which total unit costs (inventory carrying plus set up) are minimized ('After SMED').



Spaghetti Diagram

Elevator Pitch

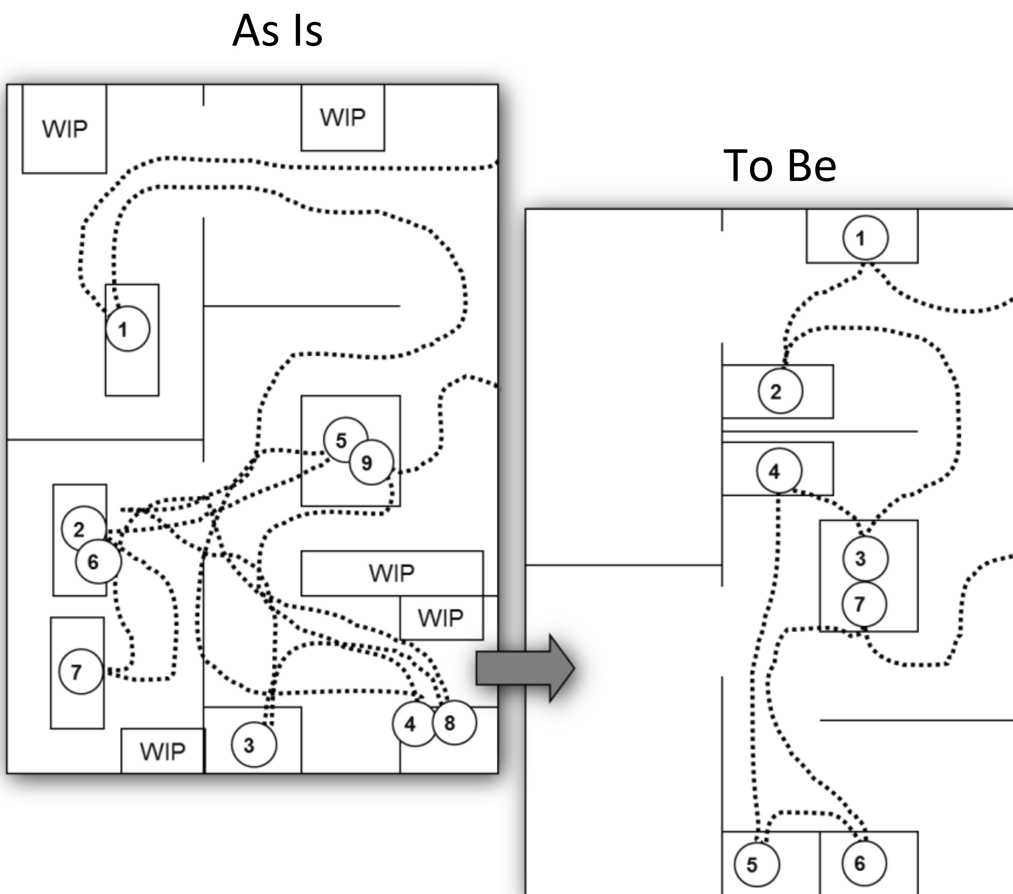
"A spaghetti diagram illustrates the actual physical flow of materials through a production process in order to design the most effective and efficient flow."

Step-by-Step

1. Get an accurate layout of the production area under study
2. Develop a sequential list of production process steps
3. Walk the floor from step to step and draw the flow on the layout
4. Take notes of area neatness, inventory, visual cues, and anything else impacting unobstructed flow
5. Analyze the flow for opportunities to eliminate travel distances and confusion

Workplace layout is a significant factor in creating a lean environment, directly driving motion waste and waiting time. If a work flow has evolved over time, it is likely that 'standard' work has evolved with it, incorporating significant material movement and wait time. The flow illustrated here is typical of that situation, with parts carried in, dropped off, moved around the stations, and eventually out the door. In this environment, it is easy to imagine rework parts mixed with good ones, time lost looking for parts, and numerous wasteful practices that keep the team busy but don't add value.

The 'spaghetti diagram,' named for the mess that too often exists, is a good place to start in developing the efficient standard work that lean requires. Once the diagram is drawn, improved flow patterns become intuitive, even when they involve immovable 'monuments.'



Ishikawa Diagram

Elevator Pitch

"An Ishikawa (or 'root cause') diagram logically connects a problem to its roots in an intuitive 'fish bone' format."

Step-by-Step

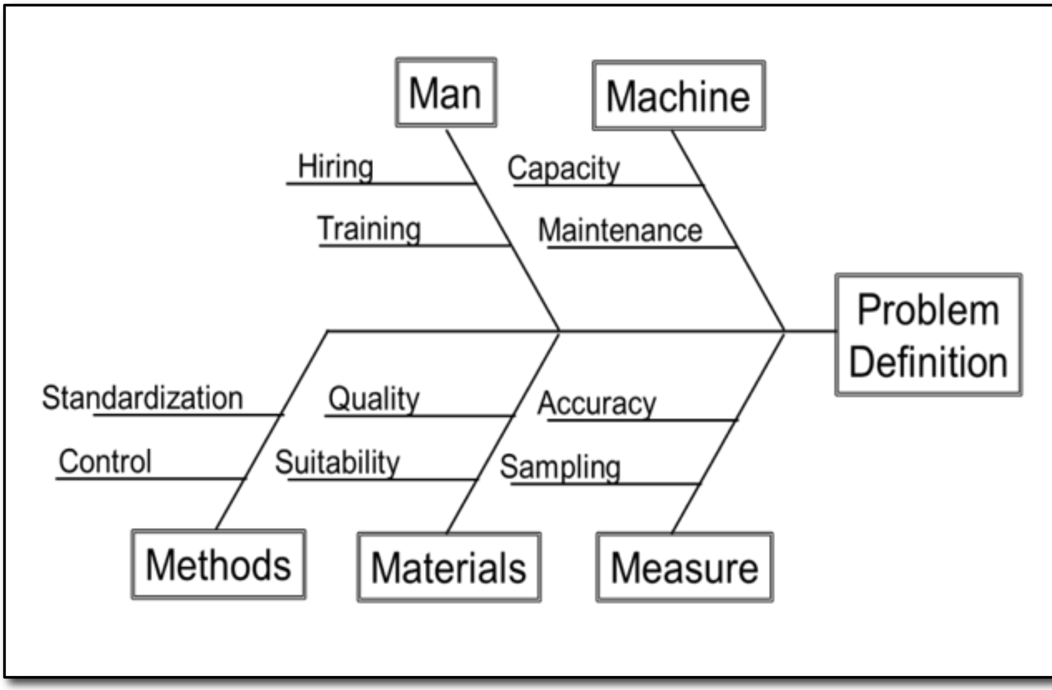
1. Correctly identify and define the problem
2. Assemble a team of experts (people who understand the problem) and brainstorm possible causes
3. For each cause, ask "why does that happen" and create sub-branches until the true roots are identified
4. As a team, develop a prioritized approach to solving the problem at its roots

The Ishikawa (or fish bone) cause and effect diagram is widely used to identify the roots of problems by successively asking 'why does this happen?' and drawing branches to represent the answer. The 5M approach illustrated here starts with the assumption that these 5 'M' factors include the 'usual suspects' in creating problems, and asks for each factor 'what prevents this from being wholly effective?'

For example, the approach asks...

- Are people skilled, trained, and well-directed?
- Are the machine capacities adequate to the requirements and are the machines well-maintained?
- Are the methods standardized, controlled, and efficient?
- Are the product's materials robust and appropriate, and are the suppliers reliable partners?
- Are the right things being measured using capable instruments?

Ishikawa diagrams are often associated with Six Sigma problem solving, but this simple 5M approach is included in this discussion of lean because one or more of the 'M' factors can easily be overlooked.



Daily Focus on Lean

Elevator Pitch

"Every work group needs a very brief stand-up huddle every day to ensure a coordinated effort. They also need an easy visual reference throughout the work day to stay focused on the critical objectives of the group."

Step-by-Step

1. Identify the target work group for a lean implementation
2. Have the affected managers and workers brainstorm the key elements of the group's mission
3. Translate those elements into a plan for information to display on the Area Goals and Metrics board, and to review in shift start up meetings
4. Continuously update and improve both the board and the meetings

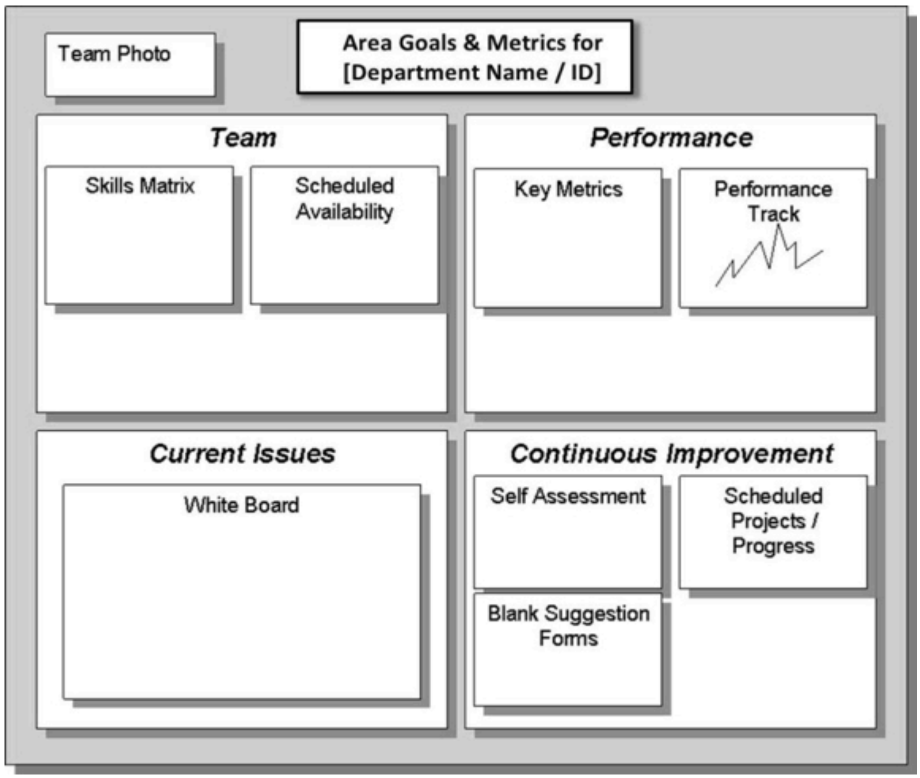
Lean must become 'how business is done' in a work environment. This means there will be visual reminders everywhere, in the form of kanbans that force the right material to the right place at the right time, highly visible performance metrics that indicate how well customers are served, and highly visible tracking of continuous improvement efforts. Suggestion boards will place improvement ideas in front of the work team for immediate consideration and action. All of these cues are focused on the serious business of competing successfully with efficiently produced, high quality output. This information is organized for all-day reference on the Area Goals & Metrics board.

Another important lean element is the shift start up meeting (or huddle), which brings each working team together to focus on each day's work. This stand-up meeting (never exceeding 10 minutes) provides an opportunity to coordinate job coverage, problem awareness, production goals, and continuous improvement progress. A designated supervisor or team leader runs the meeting for every shift.

The shift start up meeting is held in front of the Area Goals & Metrics board, which is located in the immediate work area and updated each morning. This provides an agenda for the quick discussion.

In this example note the focus on the immediate work of the team. Since this is visible to the team throughout the work day, its message is never too far from consciousness.

A Typical Area Goals and Metrics Board



Teams often assume initially that the Goals & Metrics board and shift start up meetings are 'Flavor of the Month' activities, and may erode the process by cutting corners, arriving late, or indicating that they don't take it seriously. This will eventually subside and the work teams will own the process if they see that management takes a genuine interest and that the process gains results. To ensure success, it is important to train teams well before they adopt lean disciplines, and to ensure that managers often attend the meetings and regularly participate in improvement events.

Uptime / Overall Equipment Effectiveness

Elevator Pitch

"OEE provides insights into the effectiveness of production equipment by measuring output versus capacity."

Calculations

- OEE: units produced as a % of capacity
- TEEP: units of output as a % of design capacity, in the total measured period (24/7)
- Loading: scheduled time as a % of total (24/7) time
- Availability: time actually available as a % of scheduled time
- Performance: actual output as a % of design capacity output for a period
- Quality: good product as a % of product started in the process

Overall Equipment Effectiveness (OEE) is a set of metrics that indicate how effectively a manufacturing operation is utilized relative to its design capacity. It is useful to consider OEE on a 24/7/365 basis (referred to as Total Effective Equipment Performance, or TEEP). Underlying this metric are several factors that help focus analysis teams:

- Loading, or scheduled operating time of the machine or plant
- Availability of the equipment (Uptime) considering planned and unplanned maintenance, for example
- Performance relative to design throughput
- First pass yield (quality of output)

OEE can be used to focus on a whole plant, a department, or a machine, in investigating problems with availability, performance, or quality.

Few if any operations run at 100% of capacity. Normal operations experience OEE in the 85% range.

Agile Development

The Agile Development concept was initially applied to rapid, iterative, 'lightweight' software development, but many of the team and software structures fostered have been practiced in complex hardware development in a wide range of products: computers (like Dell), major aircraft, heavy equipment, automobile, and others who apply CADCAM, design-for-manufacturing, and simulation tools to dramatically cut development time and improve initial product performance.

Lean Production enables agile development by optimizing raw, in-process, and finished inventories in a pull system, minimizing obsolete inventories for better product life cycle management. Lean also places continuous focus on changing products and processes by stressing real-time shop floor communications using daily huddles, visual cues and information boards.

Consumers increasingly expect what they want when they want it, and softeware tools have rapidly evolved to help create 'custom' products at mass-produced prices.

Elevator Pitch

"Agile Development refers to rapid, iterative design of products enabled by small, independent teams with powerful software tools in order to rapidly respond to market opportunities."

Agile Manifesto [5]

Issued in February 2001, this document states:

"We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- *Individuals and interactions over processes and tools*
- *Working software over comprehensive documentation*
- *Customer collaboration over contract negotiation*
- *Responding to change over following a plan*

That is, while there is value in the items on the right, we value the items on the left more."

NOTES:

Achieve Six Sigma Quality

Introduction

W. Edward Deming was the production statistician who developed the quantitative tools and techniques that reset quality expectations across industries worldwide. After established U.S. and European industries rejected his statistical process methods in the 1950's, Japanese manufacturers adopted his concepts and captured a significant share of world markets in automobiles, electronics, and other consumer goods before other regional markets could react. Following the Japanese lead, many consulting organizations, internal and external, have developed tool kits for continuously improving business processes.

Elevator Pitch

"Six Sigma refers to the sixth standard deviation from the mean of a normal curve, applied to production to mean about 3.4 errors per million parts produced – very high quality indeed. The term has also been extended in popular usage to refer to a program with a defined tool kit designed to produce Six Sigma quality."

With a major commitment to defense against foreign competition in the early 1980's, Motorola developed particularly successful practices to systematically improve processes by eliminating defects, and trademarked the term 'Six Sigma' to refer to its system. General Electric's implementation of 'Six Sigma' features definable, repeatable processes executed by dedicated professional 'green belts' and 'black belts.'

Mathematically, 'Six Sigma' refers to six standard deviations from the mean of a normal curve (a mathematical tool for analyzing variances). A process that achieves or exceeds a Six Sigma level of quality will by definition have 3.4 errors, or fewer, per million. Like lean production in the prior chapter, Six Sigma is a philosophy, in this case dedicated to delivering consistently the quality customers demand.

Some organizations have attempted to apply the Six Sigma concepts and toolkit to activities with relatively low throughput or non-repetitive tasks. In such cases it is better, when errors are unacceptably expensive, to use the error-proofing tools of lean rather than the process control tools of Six Sigma.

This chapter reviews the basic concepts and tools of the most effective quality programs.

Total Quality Management (TQM)

Total Quality Management (TQM) is a widely used strategy aimed at embedding quality awareness in processes throughout an organization, to improve effectiveness and efficiency while increasing customer satisfaction.

Quality assurance through statistical methods is a key component of TQM, starting with testing random samples of product for qualities demanded by customers. Root causes of any failures are identified, analyzed, and corrected. Statistical Process Control charts track production quality in real time, and when measures drift out of limits the process is fixed. The upper and lower control limits are set tighter than levels where the product would fail, ensuring the process will be fixed before failing products are produced.

Elevator Pitch

"TQM – Total Quality Management – applies statistical methods to ensure quality standards are met wherever products are made, throughout an organization."

"Quality is Free" [7]

In his highly regarded book, Phil Crosby espoused "Doing it Right the First Time (DIRFT) and outlined these 4 key concepts:

1. *The definition of quality is conformance to requirements*
2. *The system of quality is prevention*
3. *The performance standard is zero defects*
4. *The measurement of quality is the price of nonconformance*

ISO 9000

Elevator Pitch

"The International Standards organization has created a number of ISO standards for how a company should operate to create products of consistent quality. These standards have been widely accepted, and ISO 9000 certification is important for marketing across a broad spectrum of complex products."

ISO 9000 is a family of standards for quality management systems. ISO 9000 is maintained by ISO, the International Organization for Standardization and is administered by accreditation and certification bodies. For a manufacturer, some of the requirements in ISO 9001 (which is one of the standards in the ISO 9000 family) would include:

- A set of procedures that cover all key processes in the business
- Monitoring manufacturing processes to ensure they are producing quality product
- Keeping proper records
- Checking outgoing product for defects, with appropriate corrective action where necessary
- Regularly reviewing individual processes and the quality system itself for effectiveness

A company or organization that has been independently audited and certified to be in conformance with ISO 9001 may publicly state that it is 'ISO 9001 certified' or 'ISO 9001 registered.' Certification to an ISO 9000 standard does not guarantee the compliance (and therefore the quality) of end products and services; rather, it certifies that consistent business processes are being applied.

Although the standards originated in manufacturing, they are now employed across a wide range of other types of organizations, including colleges and universities. A 'product', in ISO vocabulary, can mean a physical object, or a service, or software.

Baldrige Award

The Baldrige Award is given by the President of the United States to businesses—manufacturing and service, small and large—and to education, health care and nonprofit organizations that apply and are judged to be outstanding in seven areas: leadership; strategic planning; customer and market focus; measurement, analysis, and knowledge management; human resource focus; process management; and results.

Elevator Pitch

"The Baldrige Award was created to recognize organizations with quality and performance excellence that added to America's competitiveness in an increasingly competitive world market."

Congress established the award program in 1987 to recognize U.S. organizations for their achievements in quality and performance and to raise awareness about the importance of quality and performance excellence as a competitive edge. The award is not given for specific products or services. Three awards may be given annually in each of these categories: manufacturing, service, small business, education, health care and nonprofit.

While the Baldrige Award and the Baldrige recipients are the very visible centerpiece of the U.S. quality movement, a broader national quality program has evolved around the award and its criteria. A report, Building on Baldrige: American Quality for the 21st Century, by the private Council on Competitiveness, said, "More than any other program, the Baldrige Quality Award is responsible for making quality a national priority and disseminating best practices across the United States."

Baldrige National Quality Program excellence

The U.S. Commerce Department's National Institute of Standards and Technology (NIST) manages the Baldrige National Quality Program in close cooperation with the private sector.

Normal Distribution (Bell Curve)

Elevator Pitch

"The Bell Curve is a foundational concept of statistics, applicable to a broad range of natural phenomena. It demonstrates that the frequency of any measurement decreases predictably as the distance from the mean increases."

The normal distribution, also called the Gaussian distribution, is an important family of continuous probability distributions, applicable in many fields. It is often called the bell curve because the graph of its probability density resembles a bell. The central point on the curve represents the mean ('average', μ) and variance from this point is known as standard deviation, usually denoted by the Greek symbol Sigma (σ). The standard normal distribution is the normal distribution with a mean of zero and a variance of one.

The mean is easy to derive, calculated as the sum of the measurement of all units in the sample divided by the number of units One sigma is calculated as the square root of the sum of the deviations squared divided by the number of units in the population (formula shown), while the shape of the curve requires more complex mathematics.

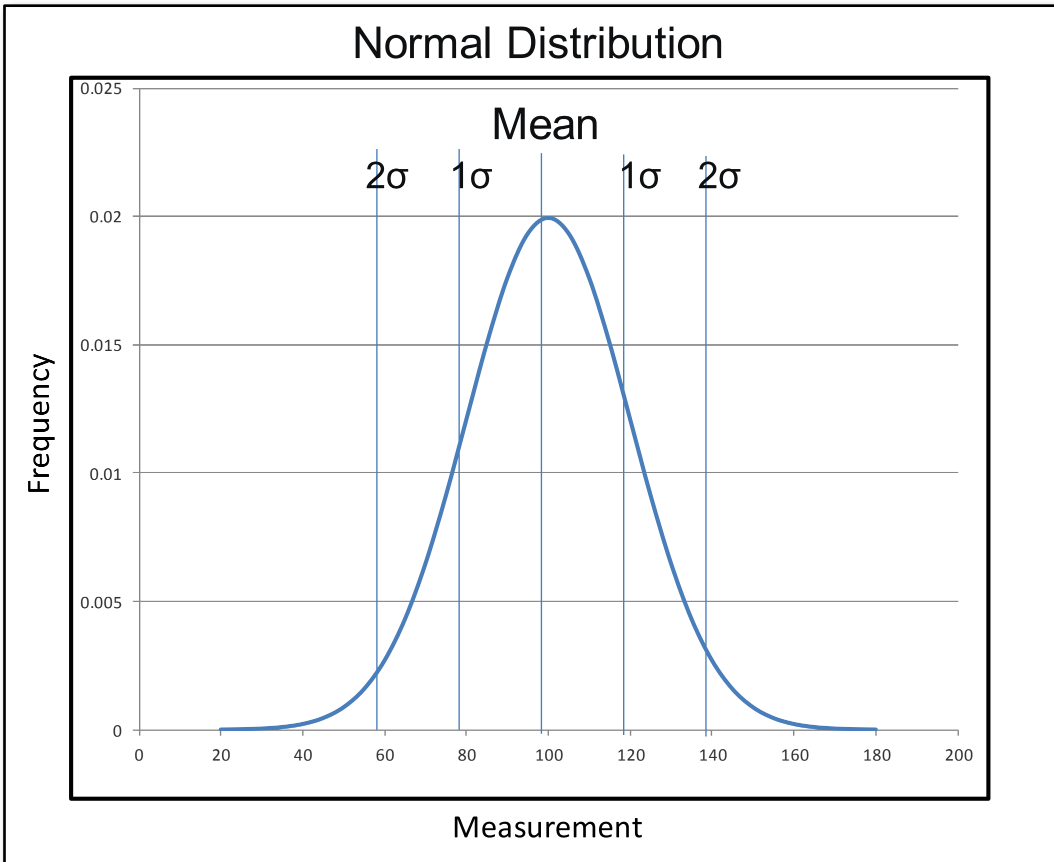
Sigma calculations indicate that 68.27% of the population will fall within one standard deviation above or below the mean, 95.45% within two, 99.73% within three, and increasingly higher percentages with each sigma step thereafter.

Six Sigma is defined in business improvement programs as 3.4 defects per million (the inverse of 99.9999966% falling within the acceptable range), though this is nominal, not a precise statistical calculation.

An example of a Bell Curve appears on page 75.

The Normal Distribution is used to predict outcomes and set expectations. A simple illustration of normal distribution is the height of adult humans. There is an average height, and variances from this average (taller or shorter) become statistically rarer as the variance increases. Whereas hundreds of millions fall within a few inches, it is very rare to find a person 2 feet taller or shorter.

In this example, if we were designing clothing for humans, we might produce many more clothes in sizes that would fit average people, and increasingly fewer as we varied further from the mean.



Histograms

Elevator Pitch

"Histograms depict the frequency of measurements along a continuum. A very large sample takes on the characteristics of a Bell Curve."

Step-by-Step

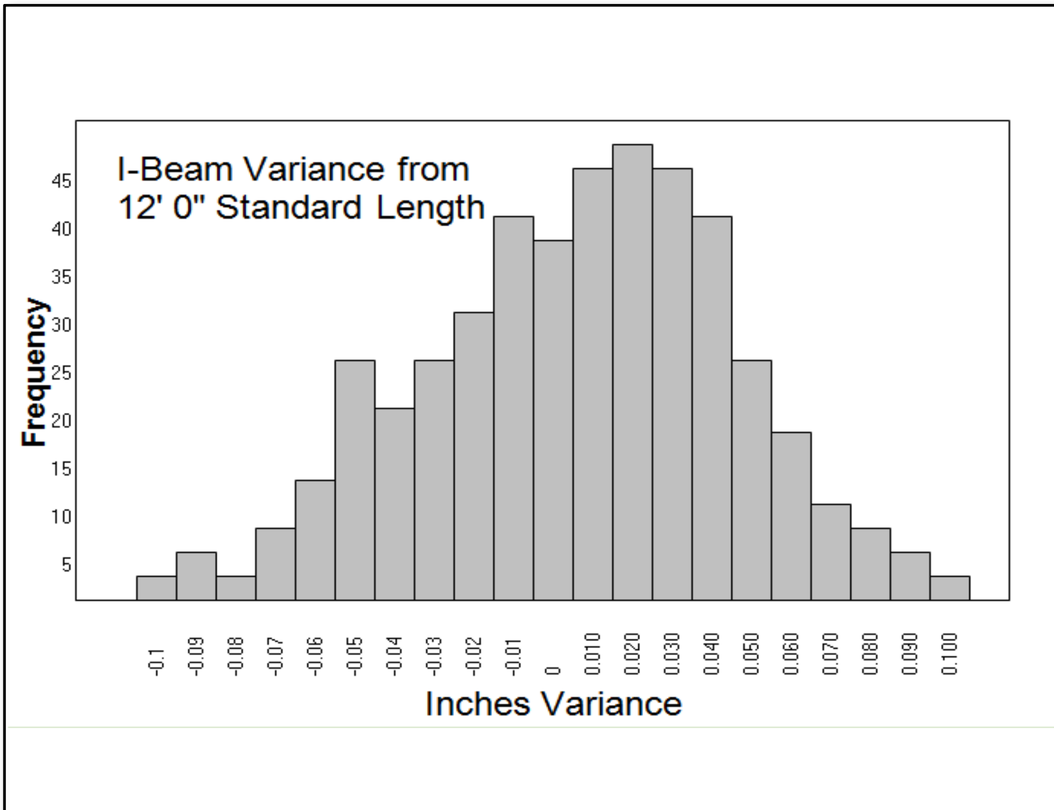
Refer to the illustration on page 77. In designing a histogram, consider:

1. How many data points will be collected (here, several hundred)
2. What the range will be (I-Beams 11' 11 1/10" to 12' 1/10")
3. How many classes of data (generally 7 – 10, maximum 20 – 30)
4. What data ranges will be represented on the chart (21, each 1/100th of an inch, centered on the standard length)

Histograms are graphic representations of how often something occurs. The metric appears on the x axis and the frequency on the y axis.

For a critical product specification, this quality tool will help the production team ensure compliance with the spec using SPC techniques described on page 78. The example illustrated (page 77) shows how often an I-Beam is produced longer or shorter than its standard length.

In this example, the histogram more nearly approximates a typical bell curve as data points are added, and production of the I-Beams appears to be controlled. If there were production problems, the curve would tend toward irregularity such as bi-modality (more than one process at work) or skewing (unbalanced control tendencies).



Statistical Process Control (SPC)

Elevator Pitch

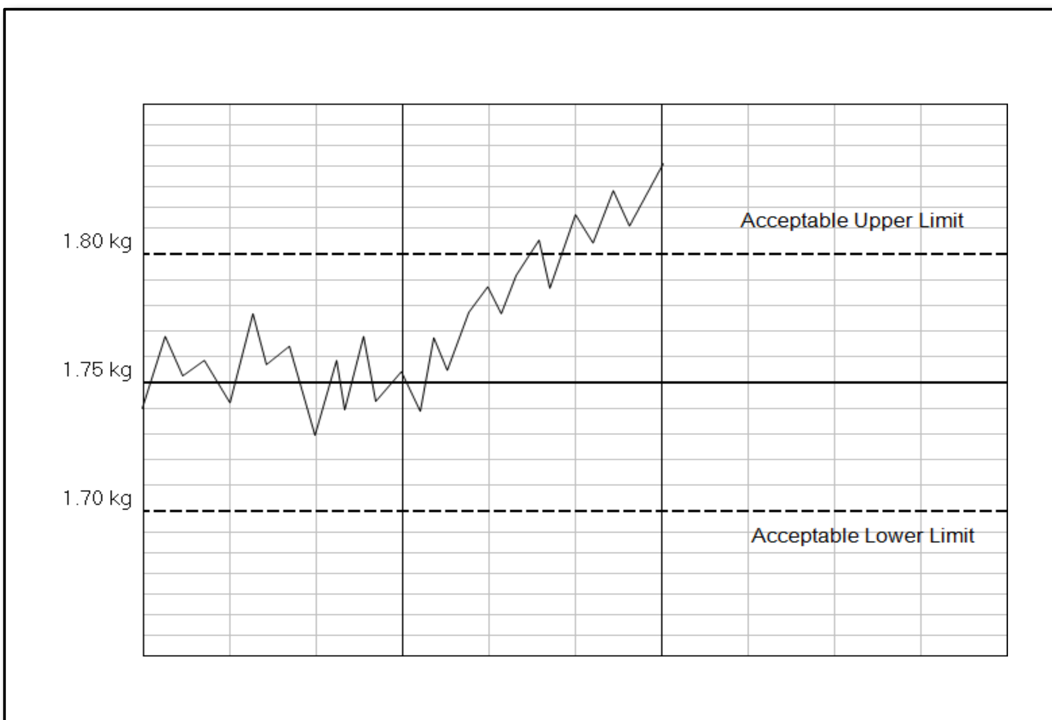
"Statistical Process Control (SPC) charts track key metrics in production to provide early warning when processes begin making out-of-spec products."

Statistical process control (SPC) is a method of visually monitoring production processes. With the use of control charts and collecting few but frequent samples, SPC can effectively detect changes in a process that may affect product quality. There is variability in any production process, and product properties usually vary slightly from their designed values even when the production line is running normally. These variances can be analyzed statistically to control the process.

If the production process, its inputs, or its environment changes (for example, the machines doing the manufacture begin to wear) this distribution can change. Process performance is typically tracked on control charts like the one illustrated, which record specified metrics for each sampled part and provide an intuitive visual impression of how precisely the process is controlling output.

In the example illustrated, a plastic parts line may be designed to create parts weighing 1.75 kg, but some parts will weigh more than the target and some will weigh less, in accordance with an expected distribution. In this illustration, It is acceptable for the plastic part to weigh .05 kg more or less than the target, and in the first part of the chart random fluctuations indicate that it is performing acceptably. But in the middle of the chart, non-random fluctuations warn the team to determine the root cause and take corrective action. In this example, perhaps the injection screw pressure is too high, causing the molding machine to put more plastic into each part than specified. If this change is allowed to continue unchecked, more and more product will be produced that falls outside the tolerances of the manufacturer or consumer, resulting in waste, in this case excess material cost or even rework or scrap.

Statistical Process Control Example



XbarR Charts

Elevator Pitch

"XBar charts track multiple samples in production to help determine whether errors are due to random events or to special causes that can be corrected."

Step-by-Step

1. Collect samples per a plan developed by statisticians
2. Create the XBar chart and the Range chart, as illustrated
3. On the Range chart, look for out-of-control points.
4. After reviewing the Range chart, look for out-of-control points on the X-bar Chart.
5. If there are any, brainstorm and conduct Designed Experiments to find and correct the root causes.

An XbarR chart is a member of a family of control charts, tools used in quality control (SPC) as originally developed by Walter A. Shewhart at Western Electric in 1924 to improve the quality of telephones. The purpose of any control chart is to help determine if a process is stable, that is, if variations in measurements of a product are caused by small, normal variations that cannot be acted upon, or by some larger special cause that can be fixed. The type of chart to be used is based on the nature of the data.

An XbarR chart is used when you can collect measurements in groups of ten or fewer observations. Each group represents a snapshot of the process at a given point in time (on the x axis), collectively showing a history of process performance in terms of Xbar (the mean measurement of the attribute being tracked) and Range (the variation of the observations within the group).

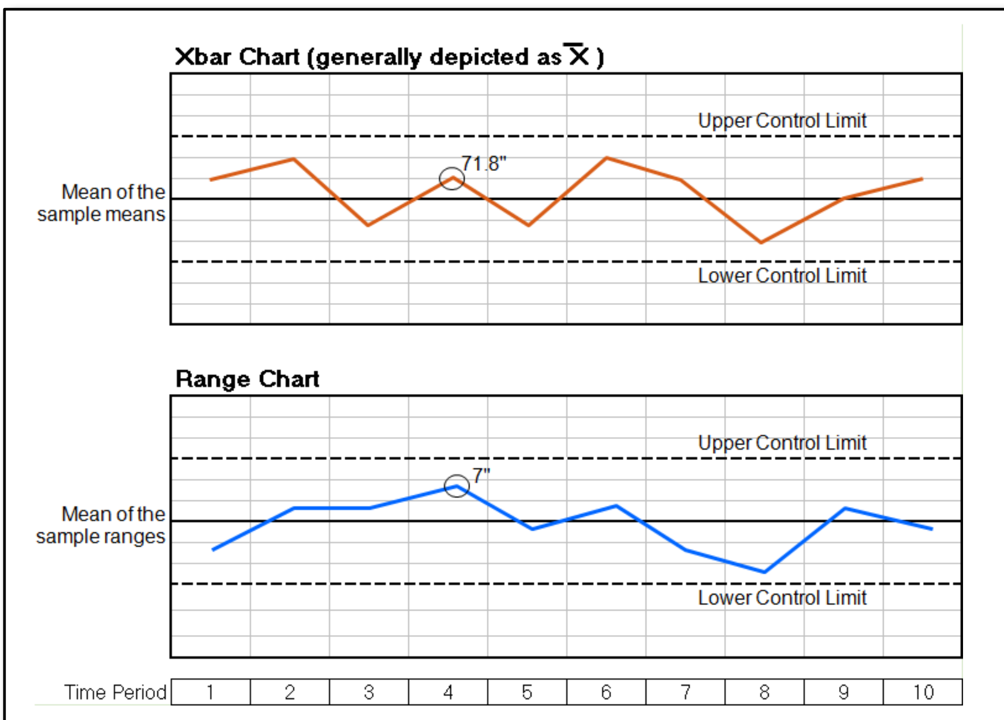
Each chart centerline represents the mean of all groups, the upper dashed line is the upper control limit or UCL and lower dashed line is the lower control limit or LCL, plus and minus three standard deviations from the overall average respectively.

In this example, the data in the top chart might represent the lengths in inches of I-Beams produced, and group 1 (the first point) might have values of 69, 73, 76, 71, and 70, with a mean of 71.8, calculated as (69 + 73 + 76 + 71 + 70) / 5.

The bottom chart has the range (R) of each subgroup plotted in a similar manner. In the case illustrated, the range for group 1 is 76 (the longest) minus 69 (the shortest) or 7 inches.

To determine process stability, the range chart is consulted first; if the range exceeds limits the process is producing bad parts. Then the X bar chart provides further insight into stability over time.

Calculations of means, ranges, and standard deviations use straightforward statistical methods found in many statistics textbooks.



Design of Experiments (DOE)

Elevator Pitch

"Design of Experiments brings a method of disciplined observation to solving business problems."

Design of experiments (DOE) is the design of manipulation, observation and analysis procedures where variation (in product quality, for example) is present to determine the causes of variation. The concept has a broad application across all the natural and social sciences, and can be applied productively to business applications.

Step-by-Step

DOE is methodical, typically following these steps:

1. Select the problem (Who, What, When, Why, How)
2. Determine dependent variables to be measured using performance measures, subjective measures, or physical responses
3. Determine independent variables to be manipulated
4. Determine the number of levels of independent variables (number of conditions to be manipulated)
5. Determine the possible combinations of independent variables
6. Determine the number of observations required
7. Redesign (if flaws or inconsistencies crop up)
8. Randomize research participants
9. Develop a mathematical model
10. Collect data
11. Rationalize and analyze the data to understand the drivers of variance
12. Verify the data

Taguchi (DOE) [9]

Statistical methods developed by Genichi Taguchi to improve the quality of manufactured goods center on zeroing in rapidly on the variations in a product that distinguish the bad parts from the good. The point is to avoid endlessly testing for all the possible defects. Taguchi Innovations in the design of experiments are considered controversial among some traditional Western statisticians but others accept many of his concepts as being useful additions to the body of knowledge.

Taguchi's principal contributions to statistics are:

- Loss-function: quality engineering should start with an understanding of the cost of poor quality, including costs to society
- The philosophy of off-line quality control: the best opportunity to eliminate variation is during design of a product and its manufacturing process

Shainin (DOE) [10]

Solving chronic quality issues has been an increasing challenge for many decades, with increasing technology complexity, narrower specification ranges, and the many factors and parameters involved making it ever more difficult to identify root causes. To address this challenge, Dorian Shainin, an influential American quality consultant, developed Design of Experiments (DOE) statistical techniques that have the advantage of being simple but powerful and widely applicable for finding the most important root causes of variation (Shainin's 'Red X') following the Pareto '80-20' rule. Shainin's DOE has a reputation for solving real life complicated quality issues and is considered a significant breakthrough in quality analysis.

Quality Function Deployment (QFD)

Elevator Pitch

"QFD is a tool used by a cross-functional team to address and coordinate product development to ensure right-first-time performance and on-going success."

Step-by-Step

1. ID customer needs, prioritized
2. Analyze competitive opportunities (Us vs. Competitors, scale of 1 to 5 illustrated, could be a useful approach)
3. Set target values for critical success criteria and plan a product for the opportunity (using characteristics such as those shown in the first row)
4. ID Critical Parts/Services and set target values for critical parts/services characteristics
5. ID critical processes and set critical process ranges/ KPIs
6. Develop process equipment to meet targets

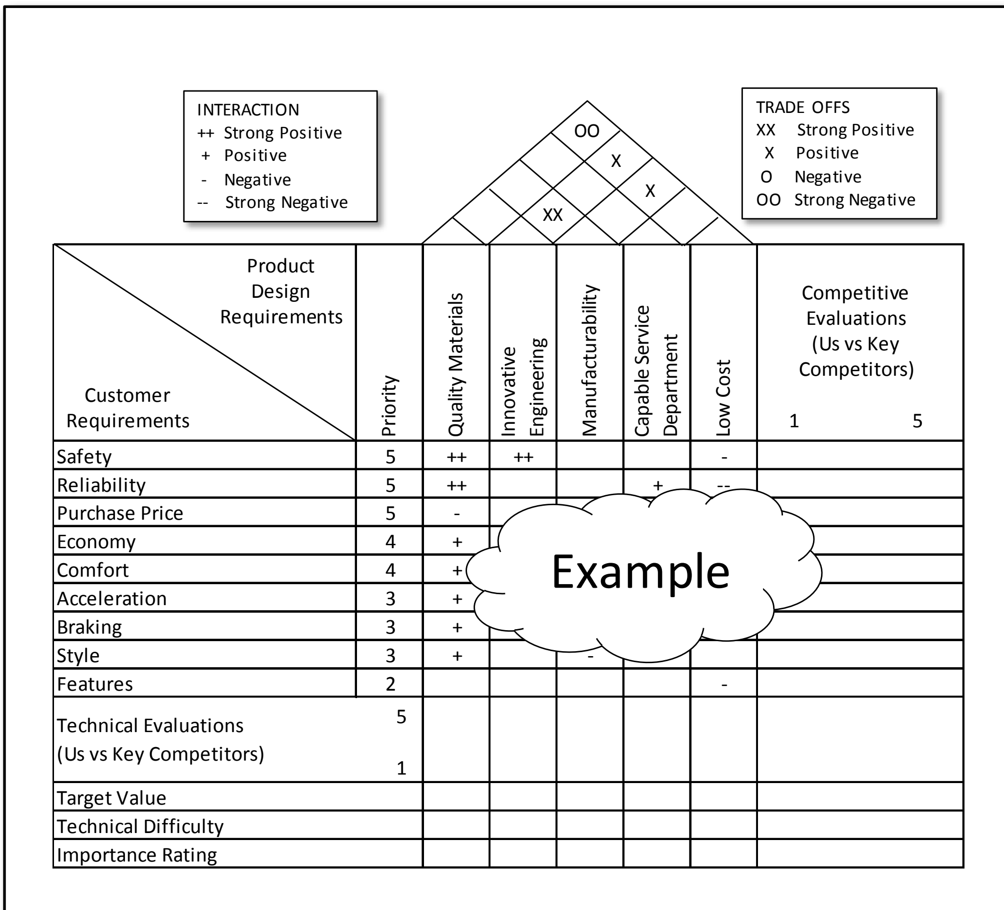
Quality function deployment (QFD) is a comprehensive group decision making tool used in product or service development and product management. QFD focuses cross-functional teams on key trade-offs to achieve performance targets for new or existing products or services, from the viewpoints of market demands, company goals, and technology realities. The use of QFD eliminates expensive rework as projects near launch. QFD is applied in a wide variety of products and services and is considered a key practice of Design for Six Sigma (DFSS).

Typical QFD development starts with the voice of the customer and considers the products needed, the critical components that go into those products, and the processes needed to produce the products effectively (right quality) and efficiently (right cost), prioritizing characteristics and setting development targets. The team can also consider technical capabilities versus those of competitors, and the degree of technical challenge, to ensure the deck is stacked for success.

QFD House of Quality

The QFD example illustrated below suggests how the interaction of demands and capabilities is depicted to highlight priorities and tradeoffs.

Quality Function Deployment Example



NOTES:

Apply the Tools to Get It Done

Tool Application Sequence

The tools used to correct efficiency problems (lean elimination of waste) and to correct effectiveness problems (Six Sigma production of products that meet customer requirements) are essentially the same, and require the same planning, teamwork and executive sponsorship to succeed.

Elevator Pitch

"Lean and Six Sigma tools are the same, and require the same planning, teamwork, and sponsorship."

Regardless of which type of problem is being addressed, the tools are used in a logical sequence to identify and analyze the problem, prioritize the fixes, estimate the challenge, and establish a project.

Purpose	Tools
Identify the problem	Brainstorming, Process Flow Analysis, Day in the Life Of (Dilo) Studies, Ratio Delay Analysis
Analyze the problem	Ishikawa Diagram, Affinity Diagram
Prioritize actions to fix the problem	Pareto Analysis, Failure Modes and Effects Analysis (FMEA), Multivoting
Estimate the challenge	SIPOC, Force Field Analysis
Establish a project	Generic Process, DMAIC, Design for Six Sigma (DFSS or DMADV)

Brainstorming

Elevator Pitch

"Brainstorming is a simple and effective way to quickly get an appropriate set of ideas about any subject. In operations analysis it is particularly effective in defining problems and hypothecating solutions."

Step-by-Step

1. Assemble the right team of experts
2. Correctly identify the problem to be solved
3. Generate ideas: post the rules of the road on the wall for reference. No idea is a bad idea while the team is freewheeling
4. Clarify the ideas: ensure the team has a common understanding of each item, and group duplicates or restatements of the same idea
5. Evaluate: discuss and prioritize or eliminate ideas to develop the best approaches

Brainstorming is used any time there is value in getting everybody's input on the table. The concept of brainstorming is intuitive, but it helps to apply it systematically, and to ensure the team understands the rules, especially:

1. Get as many ideas as possible
2. There are no silly or bad ideas
3. Everyone joins in
4. Hitchhiking (building on another's ideas) is okay
5. There are no judgments or discussions of ideas while ideas are being generated

Focus Groups

Focus Groups are organized to provide insights from about 6 to 12 individuals with points of view on a particular set of questions. For example, they are often used by product designers to try out concepts such as product look and feel, features, and the like, and are generally made up of potential users of the product. A focus group meeting is analogous to a brainstorming session, but participants often interact with each other as they react to structured ideas or questions.

Unlike brainstorming, focus groups allow the facilitator to take different roles, such as advocate for or against an idea.

Elevator Pitch

"Focus groups bring together individuals with perspective on a topic and, with well-facilitated and guided discussion, provide useful insights."

Step-by-Step

1. Assemble the right individuals
2. Correctly identify the problem to be solved and develop the questions to ask
3. Ask leading questions to guide the discussion
4. Allow the group to interact as they address the questions
5. Clarify the responses and ideas generated
6. Record the ideas and observations about the group dynamics for further analysis and application

In the world of continuous improvement, groups have been particularly helpful in responding to interview/survey questions such as those associated with the Vision Tool of this book. This meeting form can also be used to generate ideas about problems, priorities, and solutions. A particularly valuable feature of focus groups is that emotional content can be observed along with ideas and opinions.

Process Flow Analysis

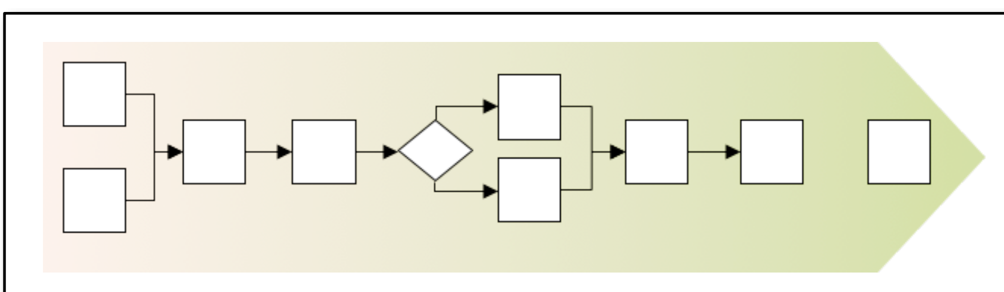
Elevator Pitch

"Processes, not people, cause the majority of operating problems. Process flow analysis is a good place to start identifying production quality or efficiency improvement opportunities."

Many performance issues stem from weak processes of all types, and very few stem from incompetent or negative individuals. Process Mapping is an effective way to identify and analyze these issues.

All business operations – information flow, manufacturing, material movement, financial analysis, executive decision-making, planning and scheduling –involve processes, and many of these cross department lines and are beyond the control or even the understanding of a single person, so a team effort is required for effective use of this analysis tool.

Process mapping is applied iteratively using key metrics at increasingly lower levels of granularity, to define problems at an actionable level. (For example, an 'Add Value' step of a process might lead to a sub-process map for 'Electronics Assembly' which might then generate a sub-sub-process map for 'Pack and Ship.') The types of metrics used to provide focus can vary, but should certainly include measurement of the number of resources and costs applied to each activity, in order to ensure focus is on high-impact areas.



When used creatively, process maps will clearly identify the major barriers to effectiveness and efficiency and will provide input into the business case supporting the change program of a business improvement road map.

Step-by-Step

1. Assemble the correct team, knowledgeable about the processes to be mapped
2. Correctly identify and define the problem
3. At the highest level, lay out the fundamental activities of the business sequentially to provide an overall map
4. Apply key metrics to begin focusing on areas for improvement
5. Develop these areas as sub-process maps, using the same techniques
6. These might also generate their own sub-sub-process maps in order to define the problems and solutions accurately at an actionable level.

Day in the Life of (DILO) Studies

Elevator Pitch

"When you need to know what REALLY goes on, follow the person who does it around and record everything he or she does."

Step-by-Step

1. Design the recording instrument, with categories based on the jobs being studied (an example appears in '04_Operations_Analysis _Forms.xls' on the available CD)
2. Schedule the DILOs and communicate the project purpose with the subjects
3. Follow the subject and record every activity
4. Combine the data from multiple DILOs and analyze
5. Create Pareto charts of activities
6. Review the conclusions in an executive workshop
7. Develop action plans to eliminate identified waste

When analyzing a process, It is always necessary to find out NOT what people think is happening, but what really IS happening. That is the purpose of the 'Day In the Life Of' study, designed to uncover significant waste such as the waste of walking around looking for people or things, wrestling with balky machinery, filling out paperwork, and the like.

Multiple DILOs are generally necessary to ensure the sample size is sufficient to support the conclusions, and the DILOs need to be long enough – at least half a shift – to record all activity. It is also, of course, critical that the data is collected in a non-intrusive way and that there is trust that the purpose is to create a better work environment.

Simple observation of random time samples will generally be sufficient to understand the improvement opportunities of simple, repetitive operations; DILOs are reserved for more complex work, such as floor supervision, where every action is recorded on an instrument as minutes falling into a few categories, such as:

- Meetings
- Coaching and directing employees
- Walking
- Break
- Looking for something
- Talking with consultant...

Ratio Delay Analysis

Ratio Delay Analysis is a form of work sampling, a statistical technique for finding out what operators and machines are actually doing. Many observations of typical activities are made at random times, and activities are recorded in various defined categories such as 'machine setup,' 'waiting' or 'idle,' 'walking around,' 'productive work,' and the like. This is a quick and effective tool for identifying improvement opportunities.

It is important to take enough observations to provide a statistically relevant sample. It is also important that observations are taken discretely to ensure the results don't reflect only the best behavior. But individuals observed should not be identified except in cases of egregious behavior (blatant disregard for safety or criminal activity, for example) – the purpose is to identify overall shop effectiveness.

When combined with process flow analysis and DILOs, Ratio Delay Analysis provides a very solid view of the 'as is' condition of an operation.

<u>Elevator Pitch</u>

"Ratio Delay Analysis provides a quick view of shop floor activity, based on a number of short observations, in order to identify improvement opportunities."

<u>Step-by-Step</u>

1. Define manufacturing tasks to be analyzed
2. Define the task categories to be recorded, such as 'working,' 'waiting,' 'walking.'
3. Design the study forms, and set the schedule
4. Prepare the team of observers
5. Make random visits to the plant and collect the observations
6. Analyze the results
7. Present results and develop an action plan to eliminate waste / improve quality

Ishikawa Diagram

Elevator Pitch

"An Ishikawa (or 'root cause') diagram logically connects a problem to its roots in an intuitive 'fish bone' format."

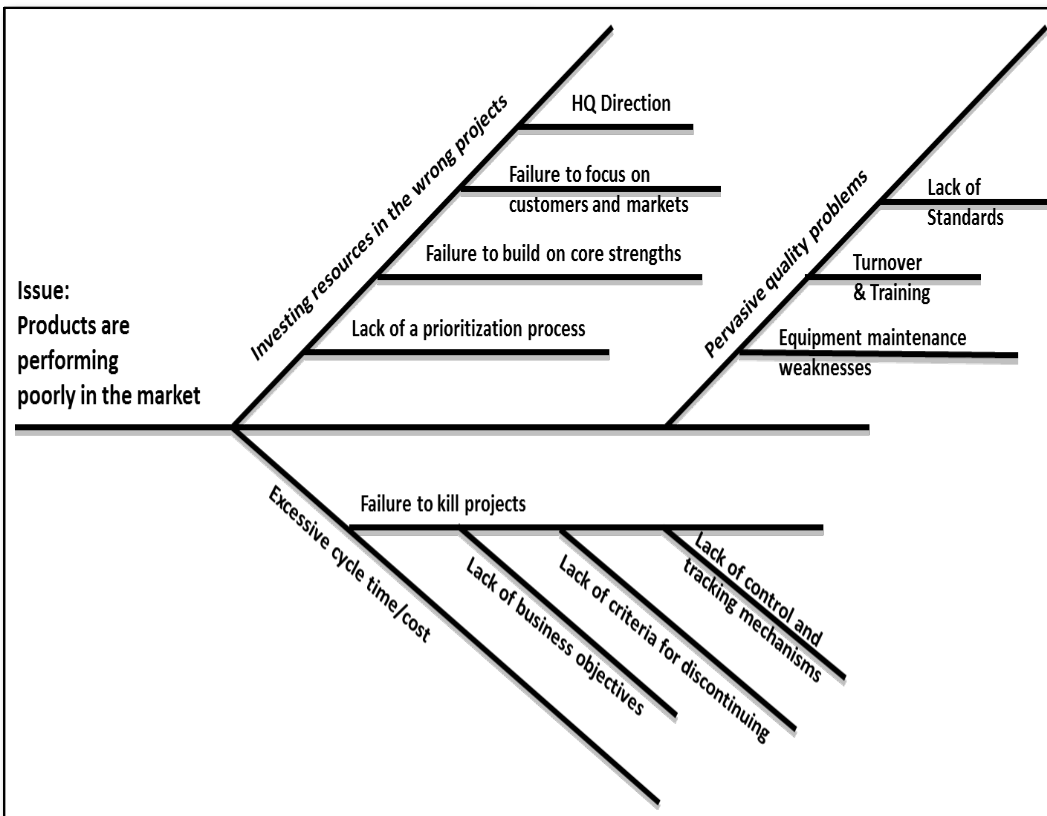
Step-by-Step

1. Correctly identify and define the problem
2. Assemble a team of experts (people who understand the problem) and brainstorm possible causes
3. For each cause, ask "why does that happen" and create sub-branches until the true roots are identified
4. As a team, develop a prioritized approach to solving the problem at its roots

The Ishikawa (or fish bone) cause and effect diagram is widely used to identify the roots of problems by successively asking "why does this happen?" and drawing branches to represent the answer.

For example, referring to the example below, "why are our products selling poorly?" If the answer is that we are working on the wrong products, "why are we doing that?" If the answer is that headquarters is directing the effort, "why are they pushing the wrong designs?" If the answer is poor business intelligence, "why can't we get them the information they need?" and so on.

In this example of an Ishikawa diagram, the issue is that products are performing poorly in the marketplace. There may be multiple reasons, such as “investing resources in the wrong projects,” or ‘excessive cycle times / cost.” In each case, ask “Why is this happening?” Misdirected investments may be due to poor directions from headquarters, poor focus on customers or markets, failure to capitalize on core strengths, or possibly other root causes – or possibly all of the above. Once every significant cause is identified, the prioritization process can begin.



Affinity Diagrams

Elevator Pitch

"The Affinity Diagram helps teams focus by organizing ideas into logically related categories."

An Affinity Diagram helps a team to coalesce around specific issues which may not appear to be related, and to think through where to focus their efforts. The example illustrated might fit any medical environment, and would provide a useful starting point for problem solving.

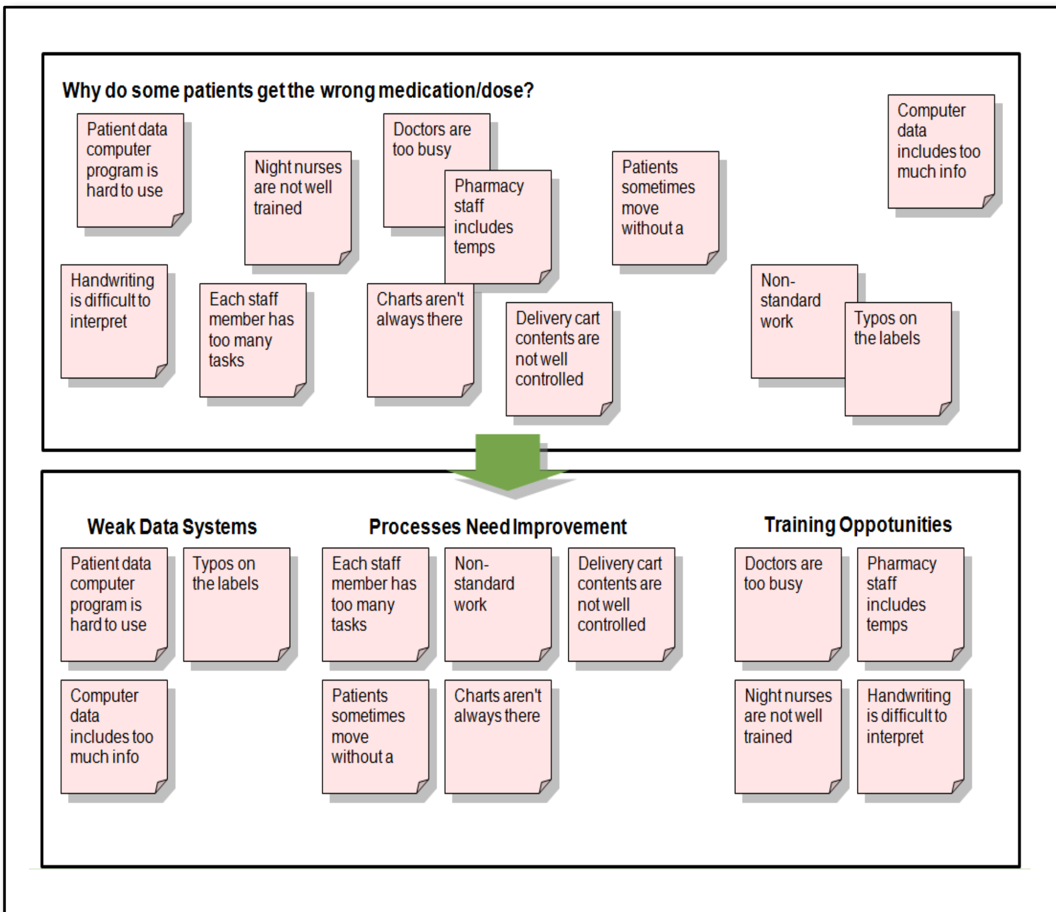
Step-by-Step

To create the diagram:

1. Assemble the team
2. Create up to 10 statements related to problem(similar to brainstorming)
3. Write them on Post-It notes
4. Stick them onto a wall or flip chart close to other related notes created by themselves or others
5. Discuss and agree on a final arrangement, moving notes as needed to gain consensus on the groupings
6. Give each group a descriptive name or phrase
7. As groupings are completed and the thinking clarified, some ideas may be killed and others refined.

In this example, random ideas have been generated in a brainstorming session. It would be possible to address each item uniquely (for example, to investigate why doctors are too busy or charts are sometimes missing) but to effectively solve a problem at its roots it helps to design a project that bounds the problem. Here, there is potential value in investigating the whole data system, some key processes, and the training systems in use.

A Typical Affinity Diagram



Pareto Analysis

Elevator Pitch

"The Pareto diagram arrays problem sources according to their frequency of occurrence, demonstrating the 80—20 rule (80% of the problems stem rom 20% of the causes)."

Step-by-Step

1. Identify the problem and its potential sources
2. Count the number of times in a sample period that each source causes the problem
3. Array the sources on a chart from most frequent to least frequent
4. Consider the ease of fixing each, and set priorities, generally starting with the most frequent

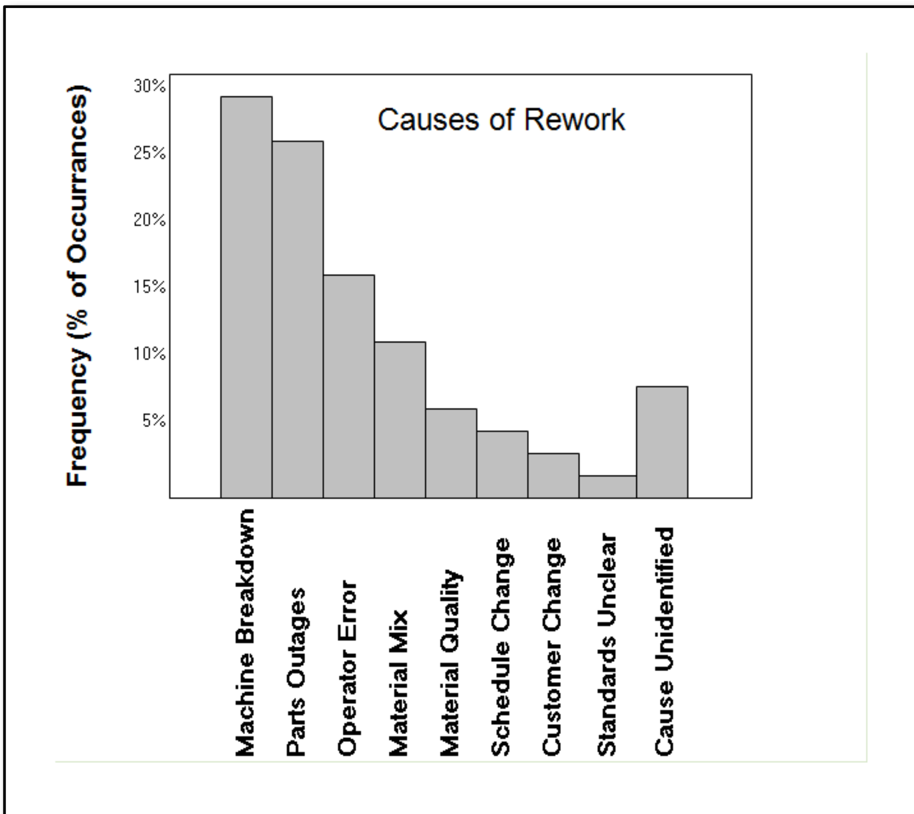
Once a problem and its root causes have been identified, Pareto analysis is an effective way to determine where to start improving the process creating the problem. The concept is simple: find out which root causes are most often to blame and start there.

The Pareto principle (also known as the 80-20 rule) states that, for many phenomena, 80% of the consequences stem from 20% of the causes. Business consultant Joseph M. Juran suggested the principle and named it after Italian economist Vilfredo Pareto, who observed that 80% of income in Italy went to 20% of the population. It is a common rule-of-thumb in business; e.g., '80% of your sales comes from 20% of your clients.
'

The Pareto principle is the basis for the Pareto chart, a key tool used in total quality control and Six Sigma. In the example illustrated, a production problem is driven most often by machine failures, suggesting the maintenance area could be improved, and almost as often by parts outages, suggesting better WIP (work-in-process) inventory methods are needed. In fact, the chart suggests a series of projects by priority, although of course some of the suggested priorities would be more difficult, more time-consuming, or less amenable to solution than others.

In this example, several root causes of rework have been identified. The analysis team then reviewed data and made direct observations to determine how often each cause occurred, providing insights to decide the most impactful actions to take.

Pareto Analysis Chart



Failure Mode and Effects Analysis (FMEA)

Elevator Pitch

"FMEA attempts to prioritize problem elimination actions based on expert understanding of severity, probability, and difficulty to detect."

Step-by-Step

1. Assemble the experts
2. Describe the parts of a system
3. List the failure modes (what can go wrong, or possible causes of failure)
4. Evaluate the risk associated with each from 1 (lowest risk) to 10 (highest risk) in terms of
   a. Severity (S)
   b. Probability (P)
   c. Inability of controls to detect it (D)
5. Calculate the Risk Priority Number (RPN = S×P×D); max = 1,000
6. Reduce the risk, usually by reducing likelihood of occurrence and improving controls for detecting the failure

Failure mode and effects analysis (FMEA) is a method used in many formal quality systems to examine potential failures in products or processes. FMEA helps to evaluate risk management priorities and to prioritize actions that reduce the risks of failure.

The FMEA process was originally developed by the US military in the late 1940s to classify failures 'according to their impact on mission success and personnel/ equipment safety.' FMEA has since been used to reduce risks on space missions and for automobile safety.

For example, an auto manufacturer might want to prioritize issues that might confront their repair facilities, in order to invest in equipment to deal with the problem, as follows:

Problem: Car Won't Start				
Possible Cause	**Severity**	**Probability**	**Detect**	**Risk Priority**
Battery is dead	1	9	1	9
Out of gas	1	7	1	7
Computer defunct	5	2	5	50
Crankshaft broken	7	1	5	35
Engine block broken	9	1	3	27

Multivoting

Assuming the right team (expertise) is in the room, multivoting can help eliminate weaker ideas and set priorities. If the team includes anyone less familiar with the topic, avoid multivoting as it will set expectations of the implied democratic process. In this example, a number of solution ideas to address an unspecified business problem have been created by brainstorming and the experts have used this consensus-building tool to rank order them.

> **Elevator Pitch**
>
> "Multivoting is a tool used to gain consensus among experts about priorities selected from a number of desirable solutions."

Idea		Total	Rank
Sell & Outsource Engineered Plasti	√ √ √ √ √ √	6	1
Replace CAD/CAM system	√	1	
Install new testing equipment	√ √ √ √	4	3
Develop new engineering processe	√√ √ √ √ √	6	1
New training program	√ √ √ √ √	5	2
Open new lab on West Coast	√	1	
Expand and exploit brand image	√ √	2	

Step-by-Step

1. Assemble the experts
2. Give each participant a set number of votes (typically 5 - 10) to be applied to any item or combination of items
3. Count the votes for each item
4. Rank order the items based on the number of votes

SIPOC

Elevator Pitch

"SIPOC is the acronym for the Supplier-Input-Process-Output-Supplier chain, analyzed to ensure key requirements and issues are understood as process improvements are designed and implemented."

SIPOC is an acronym for Supplier - Input - Process - Output - Customer. A SIPOC diagram is a tool used by a team to identify all relevant elements of a process improvement project before work begins. It helps define a complex project that may not be well scoped, and is typically employed at the Measure phase of the Six Sigma DMAIC methodology. It is similar to process mapping, but generally provides more focus and more detail.

The SIPOC tool is particularly useful when it is not clear who supplies inputs to the process, what the input specifications are, who the true customers of the process are, and/or what their requirements are.

The SIPOC View of Processes

Suppliers	**Inputs**	**Process**	**Outputs**	**Customers**

Force Field Analysis

Force Field analysis considers factors that enable progress toward a goal and barriers to achieving the goal in order to develop approaches to supporting the enablers and removing the barriers. It is particularly useful when factors are emotional or political. The following example illustrates what it might look like for a production scheduling problem.

> **Elevator Pitch**
>
> "There's always something to worry about. It is important to get it out in the open and address it."

Current State	**Goal**
Weak scheduling process drives excessive setups - up to 20 a week.	Changeover less than twice a week
Supporters	**Barriers**
Executive frustration with sales impacts Management frustration with confusion and waste Skilled scheduling staff Responsible operators Flexible maintenance team Equipment capable of long runs Strong sales / customer support teams	Changing customer requirements Emergency deliveries Disconnected IT systems & manual handoffs Inaccurate forecasts Union concerns about reduced workload

Step-by-Step

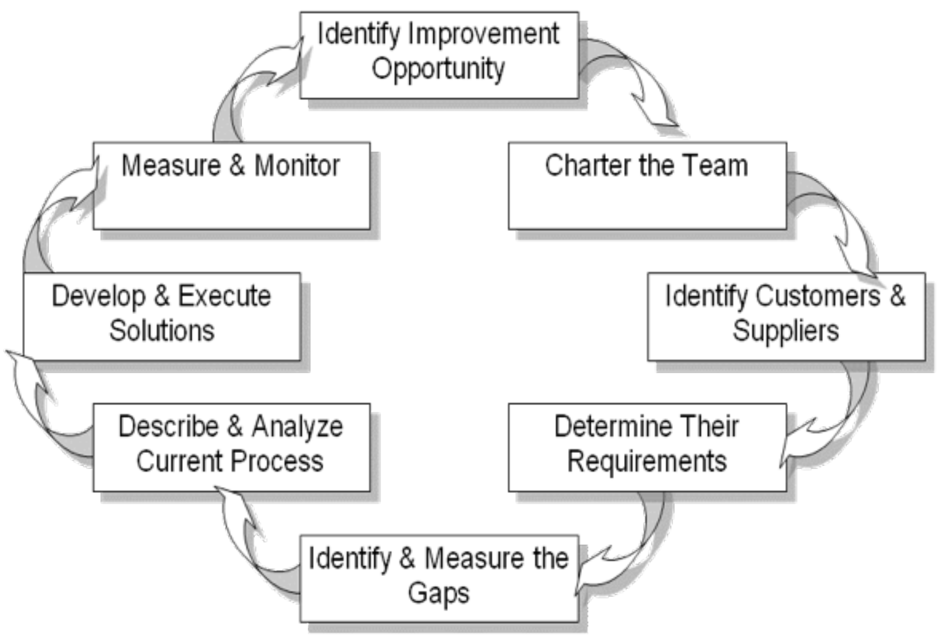
1. Describe (in headlines) the current state and the goal
2. Brains
3. torm and capture factors that support achieving the goal
4. Brainstorm and capture barriers
5. Select the most significant barriers and supporters
6. Brainstorm ways to enhance the significant supporters and remove significant barriers

Generic Improvement Steps

<u>Elevator Pitch</u>

"Failure to follow a disciplined process for business improvement practically guarantees failure to achieve the desired results."

There are many models of process improvement approaches, generated by the many consultancies that operate in this space. While this type of process appears obvious, even trivial, many teams miss steps or do them out of sequence, limiting the impact. A typical effective process is illustrated here for reference.



The typical process illustrated on the previous page outlines all of the steps needed to successfully improve any business problem. Here is more detail:

Step-by-Step

1. Identify opportunities in specific and focused terms. Ensure that the problem and its probable roots are clear and scoped correctly Charter the team. Get people with the right skills and experience involved in creating the charter they will execute.
2. Identify the customers and suppliers. If this is complex, consider using SIPOC diagrams
3. Determine customer requirements and supplier needs. Process improvements often drive efficiency, but should never degrade effectiveness at meeting customer requirements
4. Identify and measure the gaps. Develop the metrics you will use to set targets and to measure success
5. Describe and analyze the current process, to identify specific solutions and estimate their impact
6. Develop and execute solutions. If it is a large and complex implementation, pilot the solution and work out any serious bugs before rolling it out
7. Measure and monitor the results, and continuously refine the solution as required

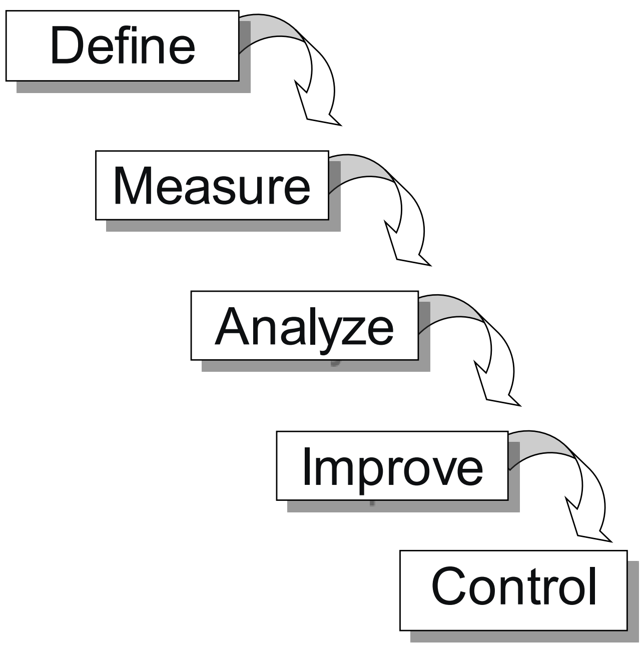
In a continuous improvement environment, this is an iterative process

DMAIC

Elevator Pitch

"DMAIC is the acronym for the most widely used Six Sigma operations improvement steps."

DMAIC is an acronym for a data-driven 'Six Sigma' approach to process improvement. Notice the overlap with the Improvement Steps process described on the prior page. To successfully improve processes, many activities are required no matter what tool or approach is used. The DMAIC steps are defined on the facing page.



Define

- Customer Critical to Quality (CTQ) issues, and Core Business Processes involved
- Who customers are, demand for products and services, and expectations
- Project scope / boundaries (stop and start of the process)
- The process to be improved (generally by mapping the process flow)

Measure

- Performance of the Core Business Process involved
- Develop a data collection plan for the process
- Collect data from many sources to determine types of defects and metrics
- Compare to customer survey results to determine gaps

Analyze

- Data collected and process map to determine root causes of defects and opportunities for improvement
- Identify gaps between current performance and goal performance
- Prioritize opportunities to improve
- Identify sources of variation

Improve

- Target process by designing creative solutions to fix / prevent problems
- Create innovate solutions using technology and discipline
- Develop and deploy implementation plan

Control

- Improvements to keep the process on the new course
- Prevent reverting back to the ‘old way’
- Develop, document and implement ongoing metrics plan
- Institutionalize the improvements through the modification of systems and structures (staffing, training, incentives)

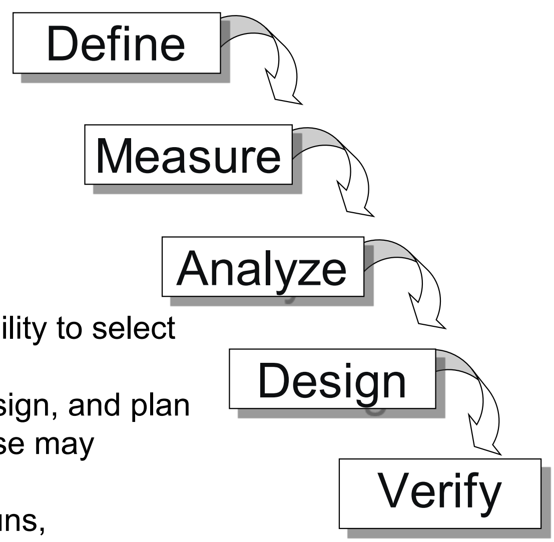
DFSS (DMADV)

> Elevator Pitch
> "Design for Six Sigma (DFSS) is the development approach to building Six Sigma quality into a product or process at inception."

DFSS (Design for Six Sigma) is an approach to designing or re-designing a new product or service with a very high quality level from its inception, building the effectiveness and efficiencies of Six Sigma methodology into the process before implementation. DFSS is also known as DMADV: (Define – Measure – Analyze – Design – Verify).

By contrast, Six Sigma DMAIC as practiced is usually focused on solving existing manufacturing or service process problems and removal of the defects by eliminating significant process variation, in continuous improvement programs after a process already exists. The DMADV project methodology features five phases:

1. ***Define*** design goals that are consistent with customer demands and the enterprise strategy
2. ***Measure*** and identify CTQs (characteristics that are Critical to Quality), product capabilities, production process capability, and risks
3. ***Analyze*** to develop and design alternatives, create a high-level design and evaluate design capability to select the best design
4. ***Design*** details, optimize the design, and plan for design verification. This phase may require simulations
5. ***Verify*** the design, set up pilot runs, implement the production process and hand it over to the process owner(s)



Case Study: Better Mouse Trap Division

Your New Job: Product Manager

<table>
<tr><th colspan="2">Your Initial Observations</th></tr>
<tr><td rowspan="5">Product</td><td>3 part plastic body with sprung steel insert</td></tr>
<tr><td>Build 5,000 per day, 365 days per year, 2 shifts</td></tr>
<tr><td>Cost (fixed and variable) $1.70</td></tr>
<tr><td>Sell $2.20, 80% to Ace Hardware</td></tr>
<tr><td>$3.1M budget, $4.0M sales</td></tr>
<tr><td rowspan="6">First walk through</td><td>2 injection molders, 1 partially disassembled (the much older, “problem” machine), the other pumping out parts at Takt rate</td></tr>
<tr><td>Crew of 2 on injection molders, appear to be pretty good mechanics</td></tr>
<tr><td>Small assembly line of 4, 2 hard at work, two chatting while waiting for parts</td></tr>
<tr><td>I utility worker moving parts and finished product</td></tr>
<tr><td>Parts all over
o Springs from China source in boxes on dock, in staging areas, at workstations
o Work in Process between each assembler
o Rejects and returns piled in a corner, some partially disassembled – your estimate: 4,000 units</td></tr>
<tr><td>Hand-written production records, messy and hard to figure out</td></tr>
<tr><td rowspan="4">Comments</td><td>Assemblers have heard you are behind on shipments to Ace and in danger of losing some or all of that business</td></tr>
<tr><td>Management has a bad rep: detached, numbers-oriented, shrill types</td></tr>
<tr><td>Lots of time lost looking for parts, fixing equipment, reworking product</td></tr>
<tr><td>Heavy turnover – 3 assemblers have less than 4 months experience</td></tr>
<tr><th colspan="2">Your Assignment</th></tr>
<tr><td colspan="2">Prepare an outline of a plan for your boss describing how you will improve this operation.
• What is the framework you will use? How will you communicate it, to whom, when?
• What are some of the key problems you will address? What priorities?
• What tools will help ensure success?</td></tr>
</table>

Case Suggestions: Saving Your New Job

Framework	'What we will become:' o Vision tool: Business Model appears okay, but there are plenty of weaknesses in the Systems for Management and Processes. Need to generate a set of vision statements that your boss and executives understand will ensure profit short and long term o Lean: many characteristics of the lean philosophy need to be fostered, especially including 5S, visual workplace, and team engagement (scoreboards, shift huddles, etc.) o Six Sigma: may be overkill for such a simple product, but some of the tools apply, including SPC and problem solving methods when needed
	'Who needs to know:' o Your boss (always first) o Other executives and managers – formal presentation of the plan, nodding heads required o Your employees – series of training sessions o Your customers – as required to ensure they aren't about to jump ship
Key Problems, Priorities, and Tools	o Save that customer, save that job: o Analyze shipments every shift to ensure on-time shipments (promise-to-delivery) o Analyze the defects 1. Place the "4,000" out of the work area and get a team to analyze what is wrong. Fishbone diagram to identify root causes, Pareto to prioritize 2. Ongoing analysis of daily output: first pass yield, Pareto of causes, SPC o Address production issues o Analyze turnover causes (might be part of the slow production problem) o Oversee 5S, standard work, balanced line, kanbans/material handling, smooth flow o Analyze the injection molding records, Pareto downtime causes, develop solutions o Identify new prospective customers – grow that base o Set goals, objectives, and the right metrics (Production rates, Yields, SPC, Product performance

Chapter 4 Apply the Tools to Get It Done

It is always a source of amazement to me to see how many business people at all levels have no idea where to start analyzing and fixing problems. Learn to facilitate your team using these simple, proven tools and make life better for them and for you.

NOTES:

Get It Done Fast with Kaizen

About Kaizen Events

‘Kaizen’ (‘little fixes’) is a Japanese term for an accelerated improvement process. It is focused on speed and agility, aimed at producing step change process improvements in a short time and a narrowly targeted area. The focus is on immediate improvement, not long term optimization. Kaizen Events are also known as Rapid Improvement Events (RIEs), Rapid Process Improvements (RPIs), Blitzes, and similar titles.

> <u>Elevator Pitch</u>
> “Kaizen events are one week workshops focused on implementing an ‘80%’ fix to a discrete problem in a production area.”

Modeled after Toyota workshops for suppliers, Kaizen Events are focused, one-week programs to implement improvements in a narrowly targeted area. A team of managers, engineers and operators work together on the shop floor to solve a process problem, identifying and implementing an ‘80%’ solution during or immediately following the event, with iterative improvements as needed later. Generally no or minimal financial investment is required.

A typical event includes 5 to 10 individuals assigned full time for about a week, all with knowledge skills to contribute. A strong facilitator is required, to keep the group focused and to add creative insights. A typical event runs about 4 days, but longer or shorter events may make sense depending on the scope and complexity of the problem addressed.

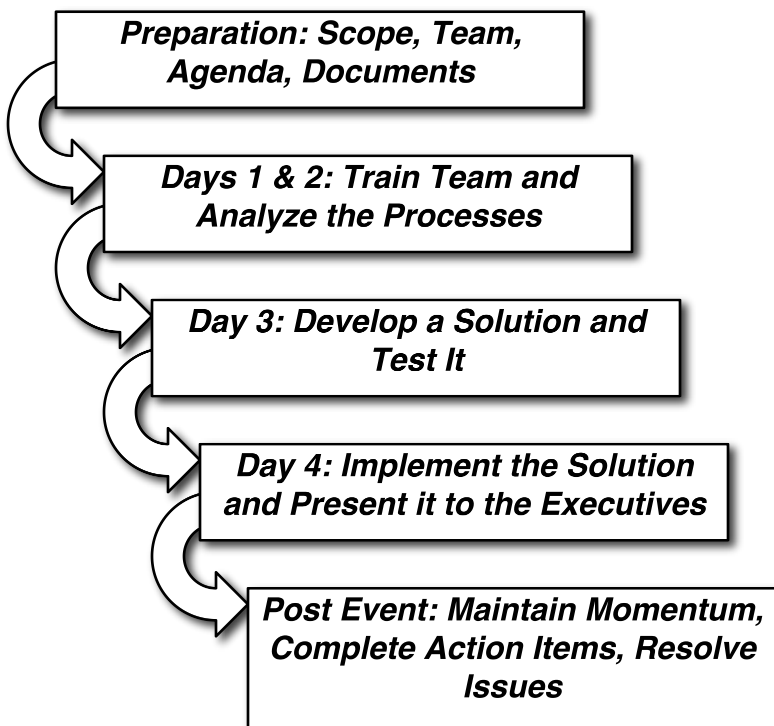
The Kaizen Event is based on fast cycles of education and application, learning how to do the event by actually using it. This is different thinking for most organizations, and often exhilarating as it:

- Creates enthusiasm for improvement, demonstrating quick results in factory and office areas, internally or involving suppliers or customers
- Provides breakthrough results, sometimes even doubling efficiency, especially

effective in the context of an overall culture change (as in a lean implementation)

With practice and experience any organization can develop Kaizen capability internally, though many organizations may benefit from using experienced outside facilitators initially, to ensure success (and deliver value) and to model the approach for dedicated internal resources as skills are built.

The Key Steps



Preparation at least one week prior to the event:

- Select the area(s) to include. It is very important to ensure that the kaizen event has an area to work in where rapid improvement is possible, perhaps identified from a Value Stream Map or similar analysis
- Define the objectives and scope. For the teams to have a sense of achievement, and for the sponsoring organization to recognize success, goals need to be set at the outset. Teams often see related opportunities in adjacent equipment/processes, but the scope needs to be narrow enough to ensure positive results.
- Organize the agenda and materials and identify the team members and roles
- Collect necessary background data and information

Days 1 and 2:

- Assemble, train and build the team
- Understand and document the current process, identifying waste activities or materials
- Visualize solutions, such as ‘5S,’ workplace organization, standard work, kanbans, etc.
- Develop the improved process

Day 3:

- Test the vision and refine it through several iterations
- Implement - plan, do, check
- Track and communicate progress

Day 4:

- Complete the implementation, report accomplishments, and develop action plan for any remaining tasks (who, what, when)
- Celebrate success

Post Event:

- Maintain the momentum and attention through ongoing team meetings or process teams
- Complete action items
- Resolve problems and conflicts

Event Checklist

The checklist illustrated suggests the duration in days of various activities for the event facilitator. You may need to add or modify items for your organization's events, but this should provide a useful starting point, and should be communicated to the event sponsor and leader to ensure expectations and commitments are aligned.

Kaizen Event Planning Worksheet ***Event Title***

Activity	Days	Start Date	Finish Date	Responsible Party	Complete?	Comments & Notes
Area of Focus & Team Selection	1.00					
Select area for event	0.50					
Select event team leader	0.25					
Select team members	1.00					
Establish preliminary event goals	0.25					
Contact support areas and secure contacts for event support	1.00					
Prepare team and support contact lists	0.33					
Event Preparation Logistics	2.00					
Arrange for training room	0.20					
Arrange for event team room	0.20					
Arrange meeting times with sponsor or area lead during the event	0.25					
Establish final presentation logistics	0.25					
Determine event supplies list	0.50					
Conduct pre-event communication meetings	0.75					
Collect any available data and create event data file	2.00					
Communicate event to focus area employees	0.25					
Determine appropriate reward/recognition activity	0.20					
Event Training Development & Delivery	2.00					
Training material needs analysis	1.00					
Training materials customization	2.00					
Training materials production	1.75					
Training materials shipping	1.00					
Training room logistics	0.30					
Deliver training to event team	2.00					
Kaizen Event	4.50					
Conduct event in focus area	4.50					
Conduct daily team leader/sponsor meetings	0.25					
Final presentation	0.50					
Create event follow-up action plan	0.50					
Event Follow-up	0.50					
Meet with event team as needed to ensure completion of 30 & 60 day follow-up items	0.25					
Celebration event	0.50					
	32.48					

Planning Form

Communication is always a challenge, and especially in a fast-moving change program. Everyone who will be affected needs to see it coming as clearly as possible. At minimum, an event form should be created, approved, and circulated to ensure everyone affected knows what is happening, who is doing it, and what the probable results will be.

This example suggests what needs to be approved and communicated.

Kaizen Event Planning Form ***Event Title***

Date Prepared	
Prepared by	
Approved by	

Objectives	1	
	2	
	3	

Area(s)	
Location of Event	

Scheduled

Week of	

Champion	
Leader	
Resources Assigned	

			√
Documents Required	1		
	2		
	3		

Estimated Dollar Benefits

- Annual P&L	
- One Time Balance Sheet	

See Attached Agenda

Event Agenda

The choice of what to include in the agenda depends on the target area. The sample shown (page 119) is typical. Some considerations in writing an agenda:

- Provide time for an introduction which allows everyone (including yourself) to introduce themselves, to develop a list of team member expectations, and to have the team leaders introduce the operating parameters and goals.
- Leaders should be given an orientation and appropriate training before the start of the event, to save time during the event.
- Try to wrap up any training before lunch, to avoid coming back to a classroom environment immediately after lunch; better to hit the floor for an exercise on full stomachs, rather than sitting through training.
- It is very important to have specific objectives at the end of each day (brief update or a more formal management review). You will need to maintain a sense of urgency throughout the process.
- Team leaders should meet daily, outside of 'team time,' to coordinate team activities, review day's progress and plan the next day.
- Keep lunch to ½ hour if possible and have refreshments always available only take brief breaks or keep process moving.

Kaizen Agenda ***Event Title***

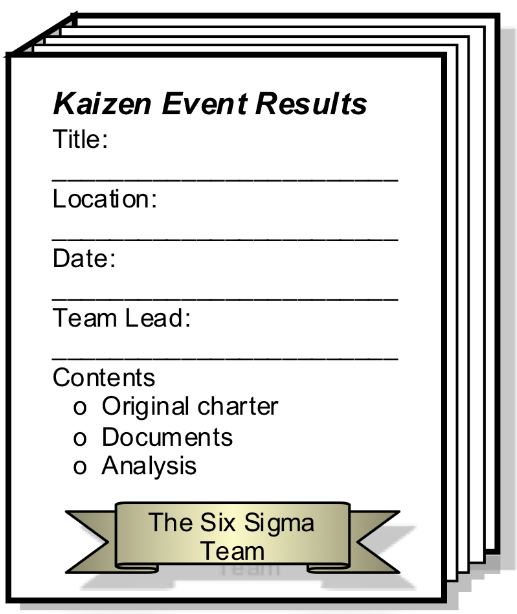
Day / Time		***Topic / Deliverable***	***Reference Documents***
Tuesday			
8:00 AM		Introduction - expectations, objectives, introductions	
8:30 AM	Training	Activity overview and waste analysis	Waste worksheet
	Analysis	"Waste walk" - identify and document waste where it occurs	
10:30 AM	Training	Visual control and 5S	
	Analysis	Red tag exercise and 5S rating	Red tag instructions 5S matrix and rating form
Noon		Lunch	
1:00 PM	Training	Standard work and pull	
2:00 PM	Analysis	Floor analysis: takt time, identify pull opportunities, complete red tag identification	
4:00 PM	Analysis	Prepare Day 1 Update	
4:30 PM	Presentation	Team Update - review findings, benefits and concerns, plan any required changes to the event	
Wednesday			
8:00 AM	Analysis	Review Tuesday activities and findings	
8:30 AM	Training	Continuous flow	
	Analysis	Part/process flow analysis	People/product flow worksheet and instructions
10:00 AM	Analysis	Floor analysis - refine and identify changes	
11:30 AM	Training	Set up reduction	
Noon		Lunch	
12:45 PM	Analysis	Floor Analysis - improvement of set ups	Set up observation form
3:30 PM	Analysis	Prepare Day 2 Update	
4:00 PM	Presentation	Interim management review of findings, benefits and concerns, plan any required changes to the event	
Thursday			
8:00 AM	Analysis	Review Wednesday activities and findings	
8:30 AM	Training	Quality	
	Analysis	Floor analysis	
Noon		Lunch	
1:00 PM	Analysis	Review status and to do items	
1:15 PM	Training	Maintenance	
3:30 PM	Analysis	Floor analysis	
4:00 PM	Analysis and Presentation	Daily review, identify Friday objectives	
Friday			
7:00 AM	Analysis	Final analysis, improvement decisions	
9:00 AM	Analysis	Prepare executive presentation	
11:00 AM	Presentation	Management presentation of results	

Documentation

Elevator Pitch

"The right documentation will prove invaluable in future reviews of kaizen events, in near term iterative improvement tweaks,long term major revisions, and financial analysis of results."

In order to ensure improvements are easy to understand and adopt, and to continuously improve the Kaizen process, it is important to document each event sufficiently. Most of the documents created are temporary, with only a few permanent process descriptions worthy of formal capture. We recommend an event notebook to organize all of the analysis data, kept by the continuous improvement team in a single hard copy, and an organized set of files on the computer system. Process flows on brown paper should be clearly identified on the outside and kept for a reasonable period by the same team. Before and after photos are very useful if there will be some physical rearrangement resulting from the kaizen event; make sure someone takes the 'as is' pictures before the event begins.

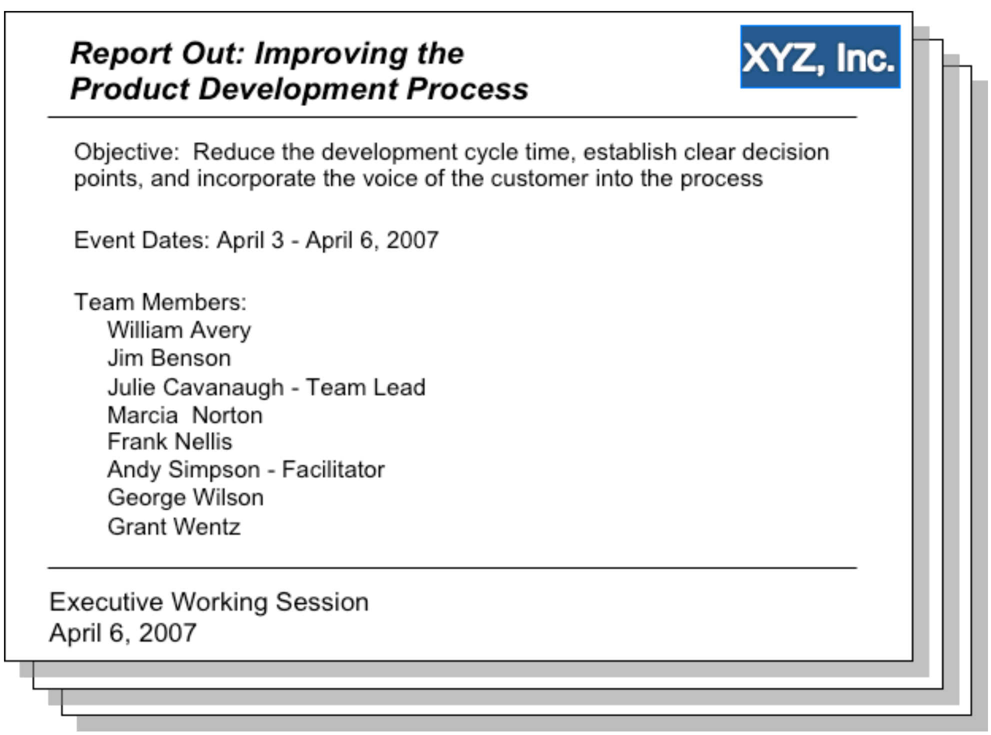


Executive Presentation

The Executive Report Out is a critical part of any Kaizen Event, for three reasons:

1. Preparing the executive presentation provides an opportunity to organize the analysis findings and the process revisions for quick, intuitive understanding. The presentation should be organized to summarize the team charter, analysis findings, description of the revised processes, actions underway, and planned follow up. Anticipating executive questions during the preparation may lead to critical insights.
2. The Report Out is an opportunity to address and possibly resolve any implementation barriers identified during the event.

3. The material can be presented by the full kaizen team, providing first hand insights for the executives and career exposure for the participants.



Roles & Responsibilities

Elevator Pitch

"The right team, with the right sponsor, can do anything."

Executive sponsorship is required to ensure a kaizen event is successful. Executive sponsors help the Event team develop the workshop and achieve its objectives. If executives are not familiar with these concepts and their role, it will be necessary to educate them prior to starting.

The Executive team must clearly demonstrate they understand area opportunities, be prepared to define and communicate workshop objectives, identify and provide full time team leaders & members, remove barriers to change by empowering the teams to make change, celebrate and congratulate teams on success, and follow up to ensure that gains hold and to complete remaining items.

The Facilitator - often an internal or external consultant - plans and directs the event, ensuring that goals and objectives are set and that the agenda is consistent with the goals. He or she must understand and may need to teach technical content and application, and must challenge teams to breakthrough levels of thinking.

Team Leaders need to be people who have recognized leadership qualities in the organization. Although they do not have to be in a formal leadership role, position power can help get things done. High potential individuals with no pre-conceived ideas are best. The role of the team leader is to help keep team(s) on track and reinforce the 'spirit of improvement.' Team leaders obviously need to understand the goals and environment of the kaizen event subject.

Team leaders should receive a 'leaders package' prior to the event that includes all kaizen event forms to be used, scissors, overheads, paper, etc., as well as any labor charging information to be used for the event. Team leaders should use the Kaizen ‘to do’ list form to track individual team assignments and progress during the kaizen event. Team leaders should be involved in the allocation of team members to the teams so they are ‘comfortable’ with the mix. It is the management team’s final decision who gets chosen but team leaders can support the decision.

Team members need to study the kaizen event subject processes and prepare and implement plans. Most team members should be from the study area but the members from outside the area provide fresh ideas or perspective and support resources (tooling, maintenance, engineering, etc.) customer or supplier point of view.

Rules of the Road

A Kaizen Event is a significant investment of resources - typically 5 to 10 person weeks - and more importantly carries a heavy weight of expectations. It is very important that each event be planned and supported well enough to succeed impressively. If the following most critical factors – minimum requirements – are not in place, do not do the event:

Elevator Pitch

“Assume at the start that the team needs rules to interact effectively and efficiently, and deal with the rules as a first order of business.”

- Listen for understanding
- Ask ‘why, why, why, why, why?’
- Be open to new ideas; focus on how to make ideas work, not why they won’t work
- Everyone participates; don’t pull rank
- Be on time and stay focused
- One conversation at a time
- Communicate with ‘stake holders’ - final decisions are made by ‘registered voters’ working in the area, whether or not on team
- Have fun!

Critical Success Factors

> Elevator Pitch
> "Ensure that the deck is stacked for success. Failure to secure any of the CSFs is a show stopper."

A Kaizen Event is a significant investment of resources - typically 5 to 10 person weeks - and more importantly carries a heavy weight of expectations. It is very important that each event be planned and supported well enough to succeed impressively. If the following most critical factors – minimum requirements – are not in place, do not do the event:

Commitment from the top

- Give teams what they need to succeed, within well understood boundaries
- Ensure support organization timely response - maintenance, engineering, purchasing, MIS, etc.
- Make sure management is available for team out briefs
- Recognize improvement efforts and results
- Have some money to spend
- Follow up to make improvements stick

Effective planning

Daily agenda

- Prepare panels, worksheets, assignments and articles that will help the team understand and focus
- Specific, measurable performance improvement goals
- Focus specifically on 'how to achieve and hold the gains'

Team construction

- Full-time team members only
- Involve people throughout the organization and from outside the organization (other plants, customers, suppliers)
- Balance organizational levels, functional and departmental perspectives on teams
- Multiple teams, operating concurrently build healthy competition
- Make reporting informal
- Establish, post in the meeting area, and enforce clear meeting guidelines - Rules of the Road

Mistakes Teams Make

Some Kaizen Events fail to deliver full value. The most common barriers to success are preventable. Watch out for situations where the executives or the team...

- Pick the wrong area or the wrong boundaries (too broad or narrow)
- Never develop a real plan
- Communicate poorly (before, during and after)
- Think they are done before they have worked the solution adequately
- Change the plan assumptions○
- Fail to follow up (and lose the gains)

> Elevator Pitch
>
> "Kaizen events, like all business improvement activities, can fail for a few common reasons. Stay alert!"

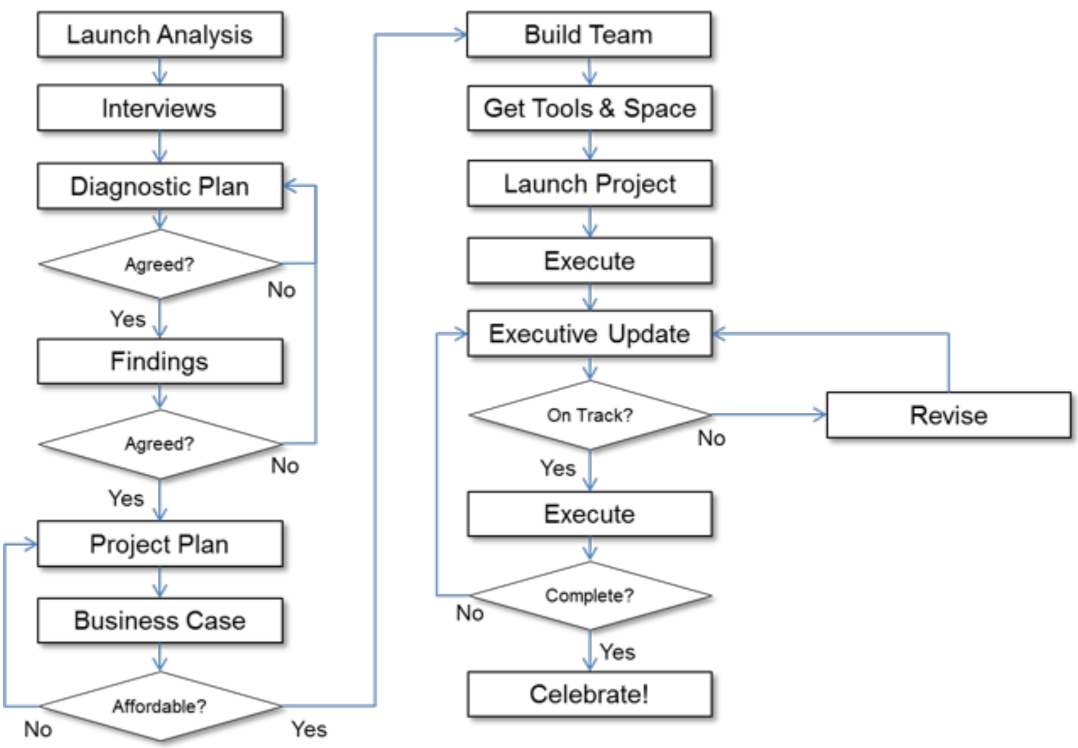
NOTES:

Organize a Project

The Flow of a Project

Projects, especially large and complex ones, succeed or fail for many reasons, most of which are related to management. The minimum requirements for success include strong executive support and highly capable project leaders, and a clear, properly scoped plan with adequate resources. Successful large projects generally follow the steps suggested in the following schematic; small projects can often be accomplished with less formality, though the basic principles apply regardless of size and complexity.

> Elevator Pitch
>
> "Following best practices in project management doesn't guarantee success, but ignoring them greatly increases the probability of failure."



Analysis Launch

It is always necessary to understand what is being fixed and the best way to fix it. The more complex the problem, the more formal and structured the analysis required. Sometimes an informal meeting with back-of-the-envelope plans will suffice; sometimes the launch requires a series of meetings with large internal and external teams participating. It is usually better to err on the side of more structure, to ensure critical participants get the word and to gauge any potential resistance.

At the time of the launch, communications to the organization can head off the rumor mill and ensure everyone knows how to support the effort.

Interviews

It is always necessary to talk to people who understand the problem. Once again, the formality and structure of this process is driven by problem complexity. At minimum, people who manage and execute the operation under investigation can add clarity and direction to the analysis.

Diagnostic Plan

Which of the diagnostic tools in this book should be applied? Guided by interviewee perceptions and common sense, the team can form hypotheses about the problem, its significance, and the best way to investigate. And again, the formality of the plan and schedule depend on the size and complexity of the problem.

In developing a diagnostic plan, it helps to start with the end in mind. What will the decision-making presentation look like? Who will need to be convinced and what will it take?

When more than one individual is involved, agreement on what and how to analyze is a prerequisite to continuing, and further interviews and discussion with decision-makers may be needed to refine the diagnostic plan.

Findings

Considerable work is required to generate a set of findings that are validated and compelling. Firstly, the team must demonstrate that each finding is accurately described, drawing on internal and external experts for the validation of facts and conclusions. Then they will need a crisp answer to the executives' "so what?" questions, including especially the financial implications of fixing the problem. This is the point where opportunities are identified and their potential impacts estimated.

Findings, and the associated improvement opportunities, need to be presented in a clear and accurate way, to ensure fact-based decisions. And the team cannot move beyond this point in the analysis until there is agreement among the decision-makers that the findings and opportunities are correct.

Project Plan

Based on the findings, the team must construct an appropriate plan for securing the benefits identified in the findings activities. The level of structure once again depends on the complexity of the work required, but the content of the plan can be summarized using the 'Project Charter' depicted later in this chapter. In addition, it is helpful to produce a schematic of the project (often as a Gantt chart, described later in this chapter), a calendar, a project control book, and similar tools and documents to help align the team and ensure decision-makers are very clear on what they are authorizing.

If there is difficulty in agreeing on project structure, It is sometime useful to start by agreeing on project principles, such as "we need to lay a solid foundation to enable the improved operation" or "we need to do this in affordable phases."

Business Case

The business case and project plan are reviewed for approval simultaneously, and any revisions required, for affordability, for example, are always linked.

Build a Team

Teams make projects successful by their skillful dedicated focus, drawing accurate inferences from the diagnostics and making real-time revisions to the analysis as needed. It is impossible to overestimate their importance. Recruit the best and brightest experienced leaders with charisma, creativity and intuition, and ensure all team members are clear on the project mission and approach, and trained on the diagnostic tools to be used. For particularly complex projects, the team building process can take a week or more, but It is time well spent.

Get the Tools and Space

Team's always need a place to work, but longer, complex projects might need a 'war room,' where schedules and presentations in progress can be displayed on the walls and the team can meet regularly to discuss progress and issues. Ensure that logistics – desks, equipment, travel arrangements, office supplies, etc. – are in place, to allow the team to focus on the project, not the working conditions.

Launch the Project

Successful projects start with a well-planned launch, in which the key points of the charter are explained and endorsed by the sponsoring executive. Here the tone is set for the team: enthusiastic support for a substantial and consequential project, or just another time-wasting flavor of the month drill.

Execute

Continuously learn as a team – critically review and improve the plan while following it.

Executive Update

To keep a project on track, regular presentations demonstrate executive interest, ensure focus on progress at milestones, and afford opportunities to course correct. Updates should be scheduled at the beginning of a project so that calendars can be aligned and key milestones agreed.

Material created for executive updates can also serve as the basis for communications for the organization, to maintain project visibility and broad support.

Executive participation is always a critical success factor, as discussed in "Get the Team on Board."

Revise

No plan is perfect, and ongoing learning often necessitates revisions. Ensure the team is fully engaged in any change.

Celebrate!

It is important to identify and reward teams and members, for both individual and organizational morale. This is the right thing to do, and it will be easier to recruit the next team when the organization sees that extra effort pays off.

Project 'Due Diligence' Questions

While planning a business improvement project of any nature, executives should be asking questions such as:

> **Elevator Pitch**
> "Ask due diligence questions (like these) up front, and resolve any issues raised before attempting ANY project. Always stack the deck for success."

- What is the rationale for the action?
- Who will be responsible for getting the work done?
- Who must be consulted before deciding or launching major changes?
- Who must be informed to make it work?
- What kind of information does your organization share in making decisions and coordinating its teams? How much openness is appropriate? How will you ensure confidentiality of critical information?
- For new products, can you demonstrate convincingly that there are customers willing to pay the prices you've assumed, in the volumes you've assumed?
- Do you have hard evidence - i.e., direct experience or solid industry data - that your cost and asset structures are reasonable?
- What are the risks of being wrong on any element? Have you quantified and mitigated those risks adequately?
- For consolidations, have you eliminated all internal sales and loans? Are all such sales and loans legitimate?
- Do your cash plans have any unusual assumptions about debt or equity markets? Are you absolutely certain cash will be available as needed? Are banks and stock markets receptive to funding companies like yours, and activities such as your scenario represents?

These fundamental questions overlap importantly with the Change Management issues described in the "Get the Team on Board" chapter. It is extremely difficult to improve an operation without the authorizers and affected workers seeing and agreeing with the rationale. Change is difficult enough without clear objectives and methodology.

Project Charters

Every project of substance needs a charter, to fix accountabilities and set measurable expectations. This example includes the sort of information needed. More complex projects could use this same high level charter, with supporting detail and individual charters for each separate work stream, as the situation warrants. This template is on the available CD-ROM for modification as needed.

Project Charter

Title	***Process Review & Improvement***
Objectives	o Analyze all of our key processes to identify problem areas and develop corrective action plans
	o Develop in-house process analysis and management skills
Problem Statement	o Our costs are at least 10% higher than competitors' costs
	o Our organization is frustrated by lack of coordination and frequent manufacturing errors
	o We do not understand our processes
Possible Root Causes	o Poor handoffs across department lines
	o Lack of clarity about who is in charge of what
Action Plan Outline	o Identify all key processes of the organization
	o Prioritize these for analysis based on their significance to the business and degree of problems
	o Establish a schedule for analysis
	o Execute the schedule and with each analysis identify barriers to success and develop a
Significant Risks and Dependencies	o Workforce is fully employed, wuth little spare time
	o We lack the internal skills to accomplish this type of work
Project Team	TBD
	TBD
	TBD
	TBD
Financial Expectations	
	Revenue Improvements
	Cost Improvements
	Asset Improvements
	Investment
Analysis Team Comments	
Sign Offs	

Project Administration and Communications

> **Elevator Pitch**
> "Lean principles apply to projects, too. There is no place for confusion and rework in continuous improvement."

Complex projects require professional administrative support to keep the team on the right page and the rest of the organization positive and supportive. Project time should not be wasted by miscues and rework. Important elements include:

- The team should always know where to apply its effort, with clear calendar and schedule control
- Executives and other key personnel should always know when, where, and why they are needed
- Employees affected by or involved in project work should also know when, where, and why they are needed
- All team members should know how to contact each other and all work or meeting participants
- All project participants should understand diagnostic or implementation tasks sufficiently to contribute effectively
- Equipment and supplies should be available when and where needed

Communications are key to many of these requirements, and may warrant professional attention for more complex projects. Typically social media, in-house magazines, a library of presentations and film clips, and bulletin board announcements suffice, but press releases and other media contacts might be appropriate for activities that impact beyond the organization.

The 'Project Admin' file on the available CD provides a template for keeping the team organized. It includes the Administrative Information form on the next page.

Administrative Information ***[Project Identification Number]***

Project Name]

Address	Phone	Fax	E-Mail

Start Date (Monday)	Weeks
22-Apr-02	6

Consulting Team Members		Phone	Mobile	Fax	E-Mail
[AAA]					
[BBB]					
[CCC]					

Internal Team Members		Position	Phone	Mobile	E-Mail
[XXX]					
[YYY]					
[ZZZ]					

Executives		Position	Phone	Mobile	E-Mail
[Top Client Name]					
[Other Decision Maker]					
[Other Decision Maker]					

Hotel	Phone	Rate	Comments

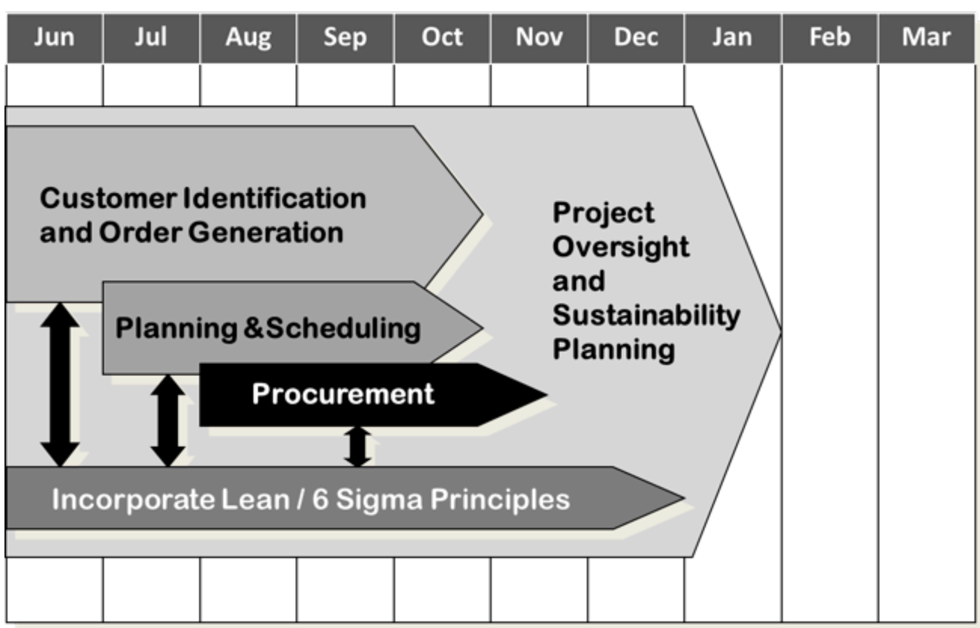
Directions

Project Overview Schematic

> **Elevator Pitch**
> "A simple schematic of inter-related work activities can make a complex project far more intuitive to executives, the team, and the organization."

In large and complex projects, work is organized into workstreams staffed with experts in the areas under review along with the employees doing the work. For example, a project with heavy IT content requires computer architects and programmers to create and install software, while industrial engineers may work in a parallel effort to improve and align processes with the software.

The sample graphic below illustrates a project focused on order management processes. This type of high level view helps executives, team members, and affected employees understand the overall business improvement project and their respective roles in it.



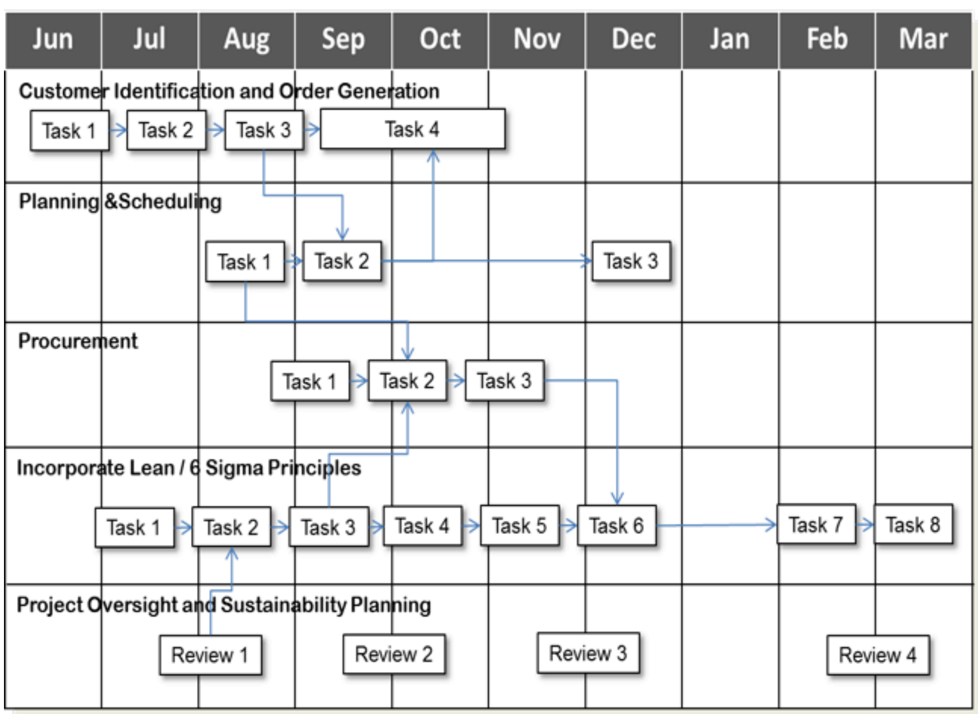
Workstreams / Swim Lanes

In the project overview example on the prior page, "project oversight and coordination" may be complex enough to require its own workstream of dedicated effort (sometimes called a 'swim lane'). Each such workstream / swim lane may have its own charter, Gantt chart, detailed schedule, and similar controls, depending on its complexity.

Elevator Pitch

"Workstream plans help organize complex interrelated work, allowing sub-teams to focus their specialized skills in the context of the whole project."

Here we imagine sequential tasks defined in each workstream, with interdependencies identified to ensure coordination during the project and in the executive updates.

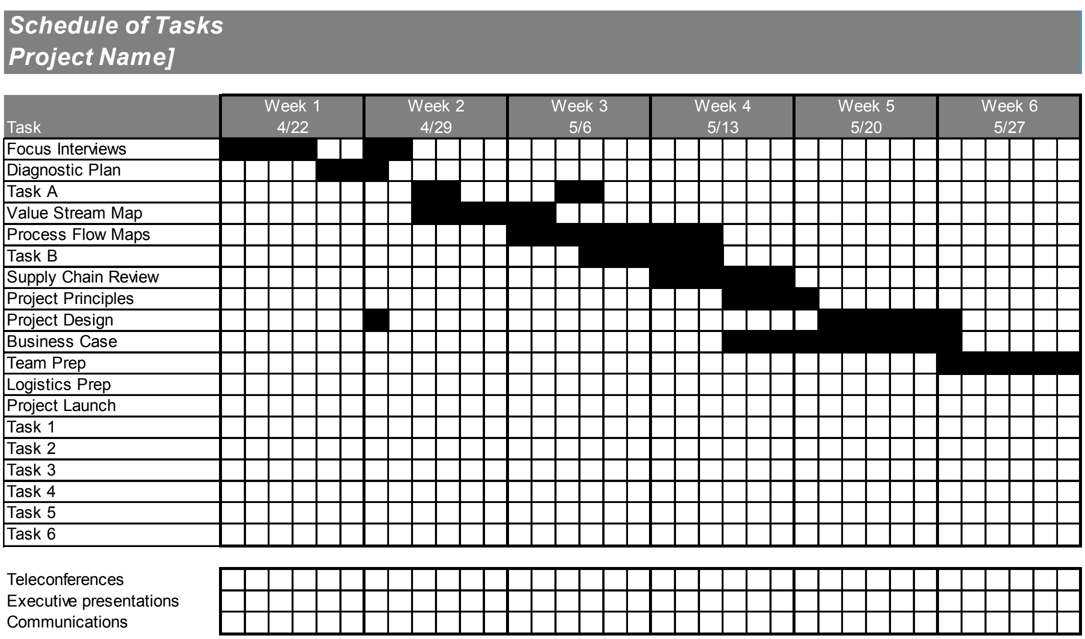


Gantt Chart

> **Elevator Pitch**
> "Gantt charts indicate start and end dates for each work activity in an intuitive visual way."

Along with the project overview and workstream charts illustrated, very detailed Gantt Charts (named for Henry Gantt, who designed the chart about 1910) can help to understand a sequence of coordinated activities.

Tools such as Microsoft Project generate excellent Gantt charts easily, though the advanced capabilities of MS Project, such as project costing, require significant overhead (assigned resources) to keep them current during the project; only very complex projects can generally afford that level of effort. The following illustration is of a typical Gantt chart, copied from the 'Project Admin' file on the available CD.



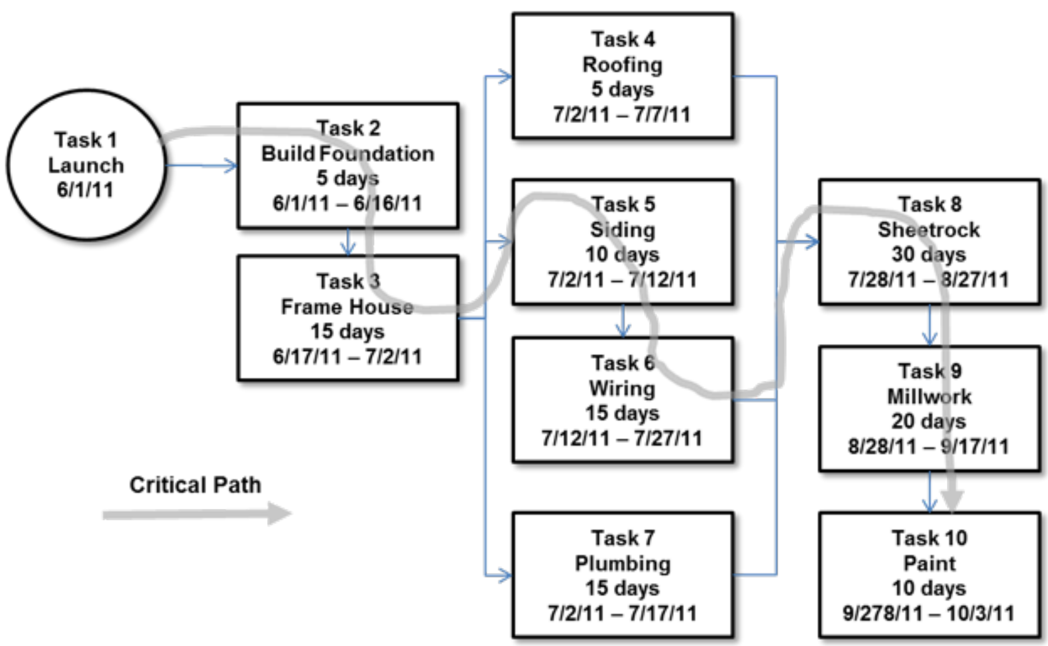
PERT Chart / CPM

PERT is an acronym for Program Evaluation and Review Technique, developed by the U.S. Navy about 1957 to help schedule complex projects with sequencing dependencies. PERT charts focus on the Critical Path Method (CPM) to ensure understanding of the impact of schedule changes as tasks must be performed in the correct sequence. In the example shown, when constructing a house, the foundation cement must dry before any framing can begin; if the concrete pour is delayed, so is everything else that depends on a foundation.

Elevator Pitch

"PERT Charts focus on the critical path to clarify the impact of a schedule change on the overall project schedule."

In this simple PERT chart, the critical path task sequence is 1 – 2 – 3 – 5 – 6 – 8 – 9 – 10. There is flexibility in scheduling tasks 4 and 7, so long as they are done by the time task 6 is completed.



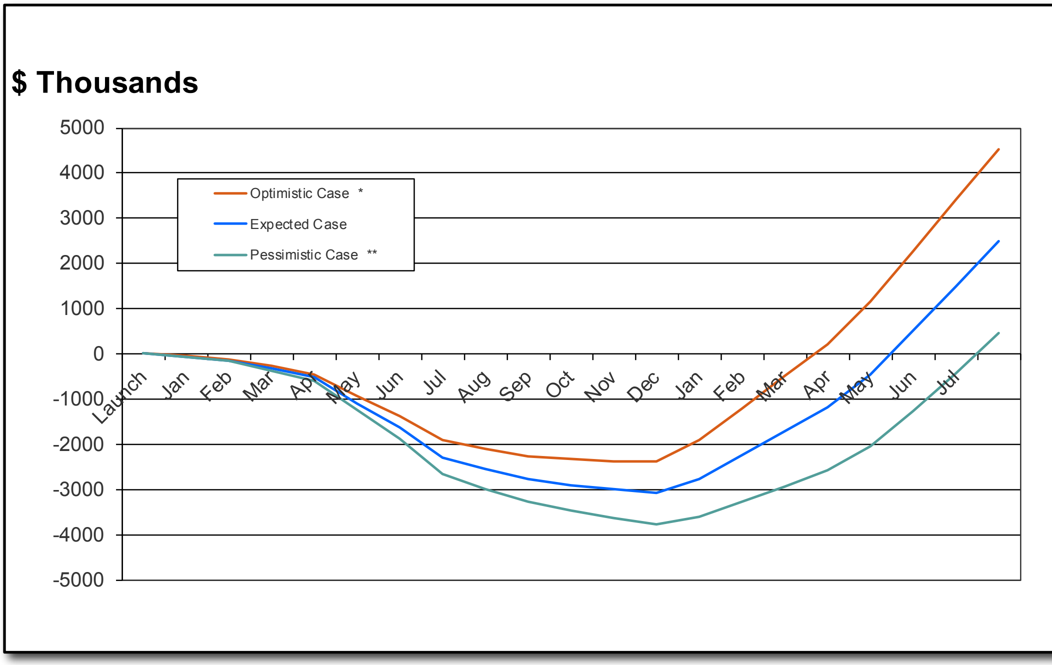
Business Case for Action

A sound business case will ensure that an investment makes financial sense (is affordable and a reasonable application of the organization's funds). This is important for the initial decision to proceed and also, as a project progresses, for maintaining focus on why the project is important.

The chart on the next page indicates the cumulative cash impact of a typical investment, with money spent before benefits are reaped. (This chart can be created by plugging values into the workbook on the available CD-ROM.) In funding a significant improvement project, consider:

- The amount and timing of all out-of-pocket incremental costs associated with achieving the desired benefits.
- The amount and timing of each financial benefit, distinguishing between cash and profitability inflows.
- The impact on the P&L, Balance Sheet, and Cash Flow statements.
- What can go wrong and how significant the risks are. In the case shown, assumptions have been made about the degree of risk, and risks have been addressed by a sensitivity analysis showing a high, expected, and low result.

Assuming an organization has the financial skills required, executives may prefer to see such decision factors as Net Present Value (NPV), Internal Rate of Return (IRR), and other Return on Investment (ROI) analyses, as illustrated on the chart.



While Chapter 10 is focused on the financial business case, it is important to note that a complete business case must also consider non-financial factors, such as strategic / competitive positioning, availability of the assets and human resources required, and political capital.

NOTES:

Map It and Understand It

About Process Mapping

This discussion is designed to help internal and external consultants quickly and effectively analyze any process to determine its ideal state, and to design interventions to improve its effectiveness and efficiency. We suggest that even the formats described are important, because many people may be involved and clear, intuitive formats will help ensure the accuracy and speed of this analysis process. This is and should look like a working document, inviting everyone who touches the process to participate. Buy in and process change management start here.

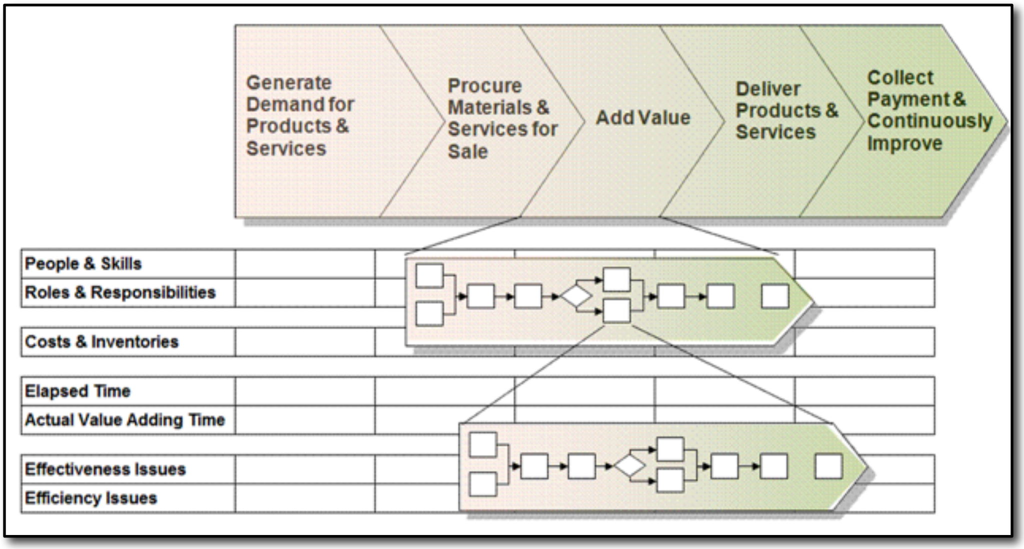
> Elevator Pitch
>
> "When you want to really understand a process-driven problem, create an 'As Is' map. When you want to really fix it, create a well thought out "To Be' map."

Note that a process map is not the same as a Value Stream map. Although they appear to have much in common – a defined starting point, steps, and measurements of inventories, for examples – they are used for different purposes. The value stream map is typically created at a macro level and focuses on reducing lead time, making value added time more efficient, rationalizing inventories, and establishing lean accounting methods. Process maps, by contrast, focus on identifying and correcting wasteful practices at the level of detail where the rubber meets the road.

Many performance issues stem from weak processes of all types, and relatively few from incompetent or negligent individuals. Information flow, manufacturing, material movement, financial analysis, executive decision-making, planning and scheduling – all involve processes, and many of these cross department lines and are beyond the control or even the understanding of a single person.

Process Mapping is an effective way to identify business problems. At the highest level, fundamental activities of a business are laid out sequentially to provide an overall map, and key metrics are applied to begin focusing on areas for improvement. These areas are then developed as sub-process maps, using the same techniques, and might also generate their own sub-sub-process maps in order to define the problems and solutions accurately. For example, the 'Add Value' step shown might lead to a sub-process map for 'Electronics Manufacturing' which might then generate a sub-sub-process map for 'Final Assembly.'

A Generic Process Map



Types of metrics used can vary, but should certainly include measurement of the number of resources and costs applied to each activity, in order to ensure focus is on high-impact areas. When used creatively, process maps will clearly identify the major barriers to effectiveness and efficiency, providing a basis for designing the future state, and provide input into the business case supporting the change program of the road map.

Creating a Process Map

Process analysis should be done following these tested steps (examples are shown on the following pages):

> **Elevator Pitch**
>
> "There is a tried and true method for creating a successful 'As Is' map."

> **Step-by-Step**
>
> 1. Assemble the materials
> 2. Assemble experts
> 3. Define the scope
> 4. Develop rough flow
> 5. Create working chart
> 6. Expert review.
> 7. Department review
> 8. Supplier and customer review
> 9. Expert analysis
> 10. Highlight strengths and opportunities
> 11. Organization review
> 12. Executive presentation.

1. Assemble the materials.
   Recommended:
   - Pink, Yellow, Blue, and Green Post-It notes - 4 packs each
   - Brown wrapping paper - typically 3 feet high and 25 feet long
   - Icons (described on the 'Templates' page)
   - Scissors, glue and tape
2. Assemble experts.
   For most processes, 2 or 3 people can develop the outline.
3. Define the scope.
   Determine the first step - what kicks the process off - and the last step - what ends the process. If the scope starts creeping, return to this step.
4. Develop rough flow.
   Use Post-It notes to capture each step (all actions, decision steps, stops, and uncertain steps). Stick them in sequence on the wall so everyone can review them, and rearrange them until the experts agree that it is approximately correct.
5. Create working chart.
   Using the icons, scotch tape the steps onto the brown paper. Leave plenty of room around each step for documents and comments. Use 'Verb - Object' format to describe each step.
6. Expert review.
   Invite the experts back to confirm accuracy or suggest changes. Update as needed and add clarification. Affix actual working documents to help clarify exactly what is happening in steps driven by work screens or print-outs. Add

7. appropriate metrics, such as how long steps take, who and how many people are involved, how much money or inventory is required, etc.
8. Department review.
   Invite the departments that execute the process to review the map and to make comments according to the instructions - pink Post-It notes for improvement opportunities, green for strengths, yellow for clarifications.
9. Supplier and customer review.
   Invite everyone affected by the process to comment.
10. Expert analysis.
    Have the experts review all comments to identify all key strengths and problem areas of the process.
11 Highlight strengths and opportunities.
    Place numbered flag icons near the steps considered strengths and weaknesses and use the flag lists to define each numbered flag. Place the lists at the end of the paper. Tag particularly useful comments for focus during presentations.
12. Organization review.
    Invite everyone in the organization to review and comment on the flow chart.
13. Executive presentation.
    Invite executives to review the chart, to ensure they agree with its accuracy and conclusions.

Identifying Key Issues

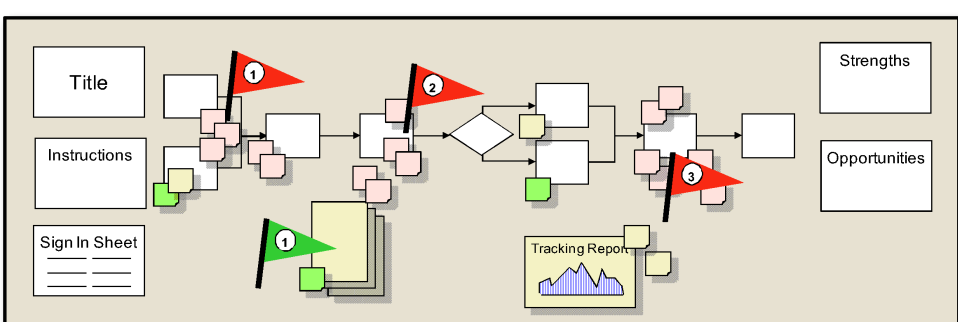
The key issues - strengths to be preserved or expanded and opportunities for improvement - are readily identified and defined if the organization has participated properly. The interactive flow chart methodology of this chapter generally generates a lot of enthusiasm, providing an outlet to air long-standing complaints and to creatively solve entrenched problems. Ensure effective communication to encourage this methodology.

Opportunities (pink Post-It notes) will tend to proliferate in areas of significant problems. Group them appropriately and define the grouping by root cause (e.g., ‘Lack of standard input controls generates many errors’ might be flagged in an area where comments describe frustration with the errors.)

At this point, also ask ‘so what?’ Look for problem areas where a lot of resources or dollars are applied, and assign higher priority to areas where focus will provide significant and visible benefits.

Here is a simplified view of a process map, showing the relative positioning of its title, the instructions, the sign-in sheet, comments, flags, and findings (strengths and opportunities). While precise positioning is not critical, It is important to include each of the elements and to make the flow of the process obvious leaving plenty of room for comments. It is also important not to make the chart too formal and finished looking (by creating it with a flow chart program, for example) as reviewers might be inhibited from messing it up with comments.

Excel templates for the common icons depicted here are included in the available workbook for your adaptation and use.



What it Means

The more people participate in developing the process map, the more it tells us. Inspect the Post It notes carefully, looking especially for things like:

- Output constraints, operating barriers such as…
- ‘Do loops,’ where work is often sent back to an earlier step for rework. Are the specifications for the work clear? Are the acceptance criteria stable? Are the production processes reliable?
- Duplication, where work routinely gets redone or re-inspected. Is quality built-in? Are the sequential operators aware of each other's role?
- Missing or substandard work, with a higher cost of rework at each successive step. Is standardized work practiced effectively all along the process chain?
- The costs of each step...
    - How many people are involved?
    - What parts, equipment, and operating supplies are used?
    - How much time does each step take? How does that time compare to Takt time?
    - How much inventory is held at each step, and why?
- How communications and coordination are accomplished (Attach documents / photographs to the flow chart where they occur, to illustrate exactly what is going on for richer understanding.)...
    - Top-down from out-of-touch executives?
    - Information broadside, with too much data to quickly communicate what to do?
    - Error-prone ad hoc, personal relationship communication?

Greater detail is usually required to actually resolve a given problem, and that level of detail is often gathered for or in a Rapid Improvement (or Kaizen) Event (RIE), described in a previous chapter.

Linking Findings to Actions

The process mapping methodology described is designed to extract improvement opportunities directly from people who deliver or are affected by a process, so that they can be addressed in an action plan. The action plan requires strong links to the source material to gain executive sponsorship and organizational buy-in.

Participants in the analysis process will also appreciate seeing that their inputs were analyzed carefully and considered by executives in continuous improvement decisions.

The chart below illustrates a format linking various planned activities to specific identified opportunities. While the format of this linkage is not important, it is important that the logic be tight and the display intuitive and engaging.

	Identified Opportunity (from Process Map)		
Improvement Project	Weak management, delayed decisions and lost opportunities	Confusing instructions and user-hostile information systems	Significant inefficiency due to reinventing the wheel and searching for guidance
Kaizen - analyze key decisions process, identify and remove barriers	Directly Addresses	N/A	Support
Analyze process - flow chart, barriers - identify Rapid Improvement Event sequence	Support	Directly Addresses	Directly Addresses
Leadership workshop - alignment of vision and strategy	Support	N/A	N/A
Review IT as part of process analysis	N/A	Directly Addresses	Support
Review desk procedures and common practices of customer data entry	N/A	Directly Addresses	Directly Addresses
Pilot desk procedures and team operating environment	N/A	Directly Addresses	Directly Addresses

Future State

<u>Elevator Pitch</u>

"The only right way to develop a 'To Be' flow chart for an improved process is with the direct involvement of the people who do the work."

Many practitioners want to start with the idealized view of a process in Visio or similar format assuming that, when the logical flow is made clear, operators will 'do it the right way.' This is seldom realistic, and the more complex the process the less realistic the assumption. That's because each activity of the current process, however wasteful and illogical, is done to solve operator problems.

For examples:

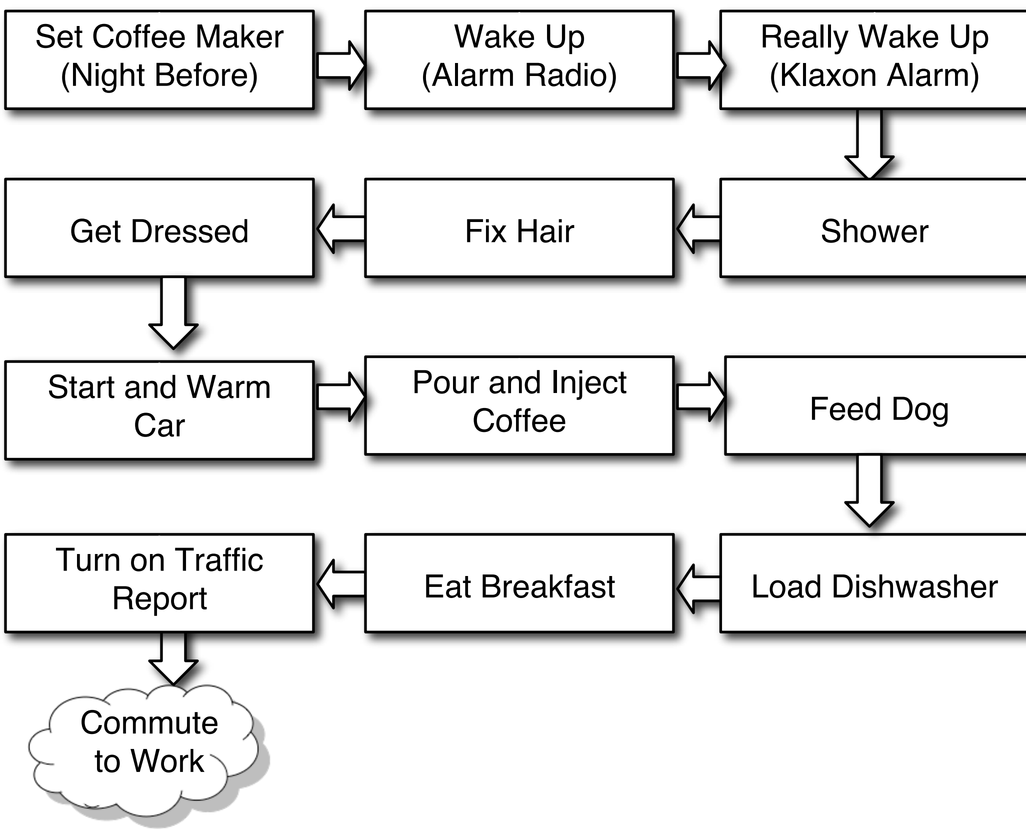
- Information not available? "We'll wait until it is," or "we'll make a decision, send the work on, and hope we are right... or that we don't get caught."
- Quality problems at the customer? "We'll inspect it again and again to ensure it never goes out wrong."
- Line stopping due to parts outages? "We'll keep the line loaded from our secret caches no matter what happens upstream."
- Machines producing out-of-spec parts? "Let's work around the problem with parallel or sequential hand operations."

The only right way to develop the correct future process is with direct operator involvement, not just because they will buy into the new process but primarily because they see firsthand what needs to be done. And using the 'As Is' process mapping techniques of this chapter, they will gain powerful new insights into how they can work cooperatively across the whole process to generate high quality output efficiently.

When the corrected process is stabilized, It is okay to generate the Visio view for training purposes and as a reference for operators. However, this 'finished' map is never final, and will always form the visual basis for evolution through continuous improvement.

In this simple and mundane illustration, we are considering the 'right way' to get up and prepare for work each day in the future. It is obvious that individual preferences and changing daily circumstances will create significant variances in such a planned process - just as they do in most daily work activities. This reinforces the need to involve the people who will do the work both in understanding what is currently being done and in what will ideally be done in the future.

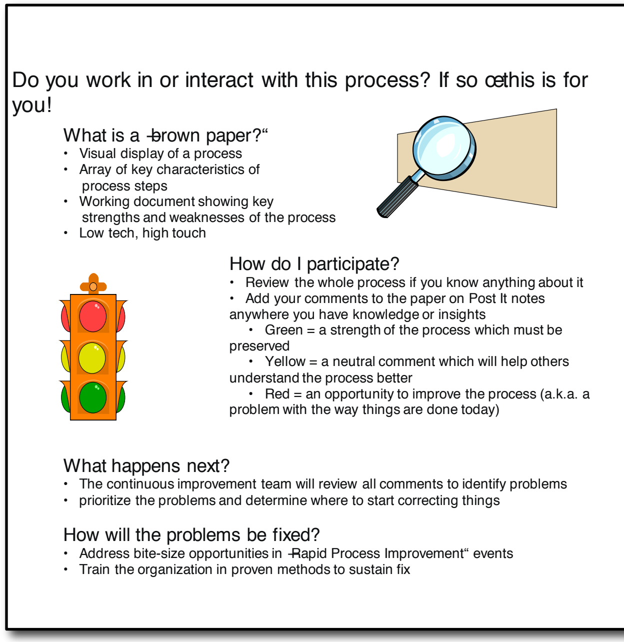
Future State?



Process Map Templates

Instruction Sheet

The available CD contains templates for your adaptation and use, formatted to print and unprotected in case you want to change them, starting with this very important instruction sheet.



To generate interest and ensure participation, It is important to explain fully what is being done and how to work with the flow chart. Some of the key points to communicate:

- Explain what a flow chart (map) is and the scheme for commenting. The red-yellow-green color scheme suggested here is very useful for rapid, intuitive communication. The energy on the map is visible from across the room, while the detailed input remains available for close inspection. This combination of a big picture with detailed support is particularly valuable in executive presentations.
- Explain what will happen next and who will do it. However, don't make promises that won't be delivered. Employees of many organizations have become jaded by flavor of the month improvement activities, and this process mapping approach is too valuable to be squandered.

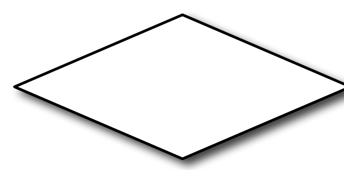
Sign In Sheet

To demonstrate authenticity of the process and accuracy of the comments, ask everyone who creates or comments on the process to sign in. This will squelch any concerns that the comments represent uninformed opinion. Executives often look for the names of thought leaders on these maps, and may suggest others not listed who can provide additional perspectives. The Excel workbook contains a sign-in sheet formatted to print.

Process Step Template

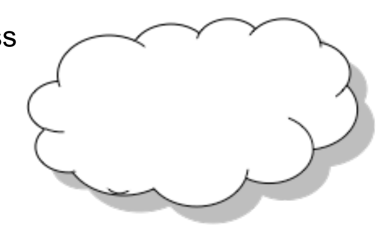
This simple box can include appropriate 'What - Who - Where - When - How' information, but must include at least the What. We suggest that all process steps be entered in Verb - Object format (e.g., 'Attach Bolts') and that any additional information be bullet points only. If clarification is needed, attach the desk procedures, documents used in the process step, resource lists, or other documents, as needed. The Excel workbook contains a page of step templates (simple boxes) formatted to print.

Process Decision Template



Processes often contain decision points which are often a source of confusion and rework. The Excel page of standard decision icons is formatted for printing.

Cloud Template



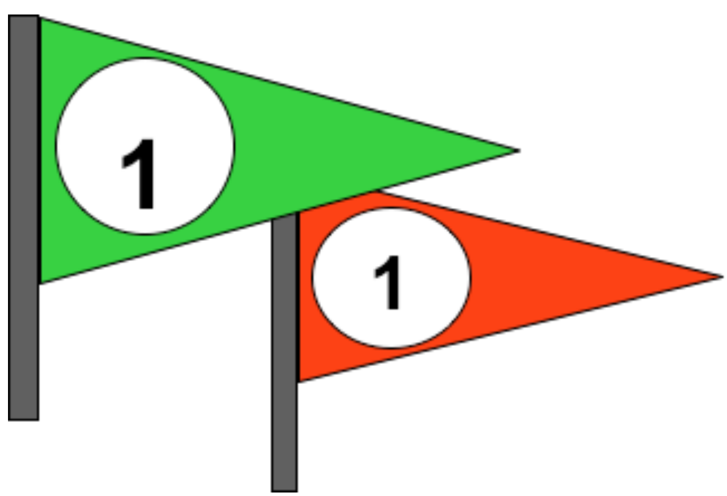
Many processes have inputs from processes undefined, either because they are beyond the process scope or because they are undocumented, informal, and subject to change. Such inputs are generally captured using a cloud icon. Uncertainties in related processes often drive confusion and errors into processes, so leave some room around the clouds for comments. The Excel page is formatted for printing.

Flag Templates

As we discussed under ‘Identifying Key Issues,’ groups of pink Post It notes (opportunities) can usually be characterized by one headline statement summarizing the comments and their root causes. The Excel page in the available CD is formatted to print four pages:

- Nine red flags to be placed near opportunity comment groups (pink Post It notes)
- Nine green flags to be placed near groups of green (strength) Post It notes
- A summary page to write headlines associated with each red flag
- A summary page to write headlines associated with each green flag

While setting the flags, It is useful to tag specific comments for reference during executive reviews, to demonstrate the link between identified problems and primary sources.



RACI Charting

RACI is an acronym for 'Responsible-Accountable-Consulted-Informed', referring to the roles and responsibilities of everyone in an organization. For every step of a process, and for every activity of a function, a single person is accountable – the buck has to stop somewhere.

That person, or another(s) delegated by him or her, is/are responsible for taking the action or completing the process step. It is not uncommon to find confusion about how work is to get done, and a process map is likely to identify this confusion.

It is also important to consult individuals who are accountable for activities or process steps that will be impacted by process or functional changes being considered.

And there are others, responsible for impacted processes or activities, who need to be informed to ensure a smooth transition to new operating procedures.

Elevator Pitch

"If everyone is accountable, NO ONE is accountable. It is always important to know who is supposed to be in charge."

Step-by-Step

1. Start with a process flow chart.
2. Identify all key actions and decisions.
3. Have the team identify the individuals accountable, responsible, to be consulted and to be informed for each action or decision.
4. Solicit comments (on Post-It Notes) about the RACI effectiveness for the various steps.
5. Resolve 'As-Is' process flow issues.
6. Follow up with executives and managers to ensure any RACI confusion identified is addressed.

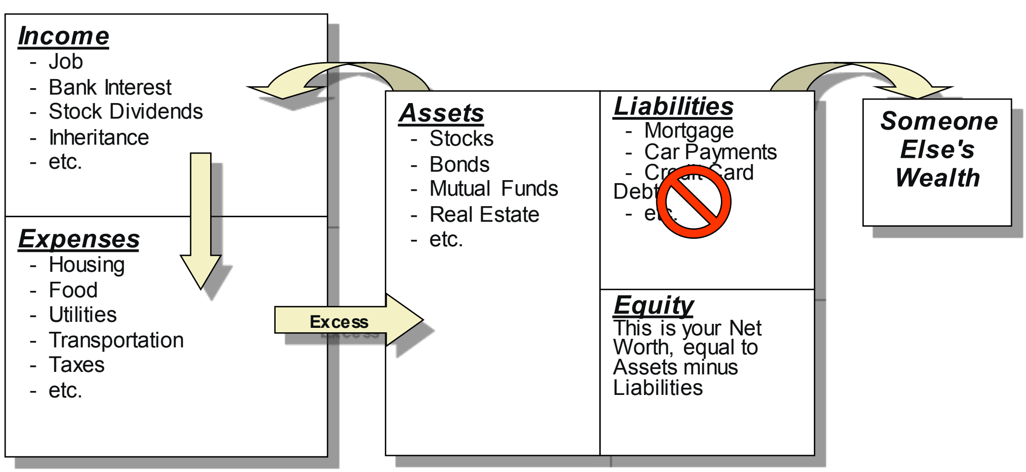
NOTES:

Be Financially Literate

Personal Financial Statements

It is sometimes helpful to relate business financial management to something we really care about, our own personal finances. The principles are exactly the same: don't spend more than you or your company can afford, don't run out of cash. Financial success has four determinants: how much money comes in, how much goes out, what you own, and what you owe. The schematic on this Intro page shows a super-simple Income Statement, Balance Sheet, and arrows indicating Cash Flow.

> **Elevator Pitch**
>
> "Keeping records in broadly accepted standard formats can help ensure you spend less than you earn and don't run out of cash."



P&L Concepts

The P&L (Profit and Loss) is a standard financial statement that presents revenue, costs, and the resulting profits for one or more fiscal periods. Translation: how much money came in from all sources, and how much was spent for everyday living. The temptation is to use credit and spend more than comes in, almost guaranteeing that income will never get far ahead of the expenses.

Balance Sheet Concepts

The Balance Sheet is a standard financial statement that presents assets, liabilities, and equity at the end of a fiscal period (often a calendar year). This statement describes what is owned (assets) and who owns them (creditors own the liabilities, The company owns the equity (Net Worth). Balance refers to the fact that Assets are exactly equaled (balanced) by Liabilities and Equity - every penny of asset value has an owner.

Cash Flow Concepts

The ‘Cash Flow’, or ‘Funds Flow,’ or ‘Sources and Uses’ is a standard financial statement that shows how cash was obtained and used in a fiscal period. This statement may be useful monthly when special cash flow challenges occur. For wealth building, the long view (annual) is helpful.

The arrows in the diagram on the previous page suggest some of the direction of cash flow, from earnings to expenses for example, but not all cash flow is depicted here. Cash can flow when:

- An excess of earnings minus expenses flows into assets (as cash)
- Assets are purchased for cash (equal to the value of assets purchased)
- Assets are sold for cash
- Liabilities are increased (for example, cash can be borrowed from the bank)
- Liabilities are decreased (for example, cash can be paid back)
- Equity is increased (cash from investors)
- Equity is decreased (dividends or stock repurchases)

Often, balance sheet changes are not cash transactions. For example, vendors may ‘lend’ in the form of raw materials. Nonetheless, this shows up on the Cash Flow Statement as cash from a Source (the vendor liability) and cash to a Use (raw material inventory).

Chart of Accounts

A Chart of Accounts could be characterized as a hierarchical numerical index of financial elements designed for sub-totaling into meaningful categories. For example, line 5110 could be direct materials used to manufacture products and line 5120 could be direct labor, subtotaled in the 51xx line as Cost of Goods Sold. In this manner, bookkeepers can enter transactions into the books accurately and complete Profit and Loss (P&L) Statements and Balance Sheets can be constructed.

> **Elevator Pitch**
> "The Chart of Accounts provides a road map for accountants, ensuring all financial transactions will be booked consistent with intelligible financial reporting."

Different industries, and companies within an industry, use different naming conventions in their financial statements. For example, the elements that add up to Cost of Goods Sold may be less meaningful in a service company than in a manufacturing firm. Within GAAP rules you may eliminate lines altogether or change their names to suit your reporting needs. IIf uncertain about the structure you should set up, consult your accounting advisors.

Account	*Category*
1000	Assets
1100	Current Assets
1110	Cash & Marketable Sec
1120	Accounts Receivable
1130	Inventories
1200	Noncurrent Assets
1210	Fixed Assets
1215	Accumulated Depreciation
1290	Other Assets
2000	Liabilities
2100	Current Liabilities
2110	Accounts Payable
2190	Other Current Liabilities
2200	Noncurrent Liabilities
2210	Notes Payable
2290	Other Liabilities
3000	Owners Equity
3010	Paid In Capital
3020	Retained Earnings
[illegible]	Stockholders Equity

General & Sub-Ledgers

A General Ledger is the main record of all financial transactions of an organization. Using the Chart of Accounts as a road map, it shows (with double-entry bookkeeping methods involving debits and credits) where money comes from and goes to.

Sub-ledgers support the general ledger with details. For example, an asset sub-ledger might have numerous transaction dates and amounts, with the net value of all of them reconciled to a single line of the General Ledger.

Profit & Loss (Income) Statement

Financial statements have evolved over the years to show in standard, easy to read format what a company owns and owes, whether it is making or losing money, and whether its cash flow is positive or negative. The P&L is the standard financial statement that presents revenue, costs, and the resulting profits for one or more fiscal periods – showing whether the company is making or losing money.in business) are factored in. If you are not making money on this line, raise prices, cut costs, or exit the business!

One of the most significant lines on this statement is 'gross profit,' indicating the amount earned (or lost) on each sale BEFORE any of the overhead (costs of being in business) are factored in. If you are not making money on this line, raise prices, cut costs, or exit the business!

Typical P&L Statement

	2014	2015
Gross Sales	**191,653,001**	**202,460,000**
Less: Returns & Allowances	2,750,600	2,024,600
Net Sales	**188,902,401**	**200,435,400**
Total Materials	40,614,401	42,962,000
Total Labor	21,057,054	22,270,600
Depreciation	4,765,241	5,100,000
Other Factory Overhead	8,469,925	8,000,000
Total Cost of Goods	**74,906,621**	**78,332,600**
Gross Profit	**113,995,780**	**122,102,800**
Gross Profit Margin	60.3%	60.9%
R&D	10,737,085	9,000,000
Marketing & Sales	36,800,337	40,000,000
General & Administrative	17,694,505	18,000,000
Interest	2,365,897	2,200,000
Total Period Cost	**67,597,824**	**69,200,000**
Net Profit Before Tax	**46,397,956**	**52,902,800**
NPBT Margin	24.6%	24.9%
Tax @ 34.0%	15,775,305	17,986,952
Net Profit After Tax	**30,622,651**	**34,915,848**
NPAT Margin	16.2%	16.4%

Balance Sheet

The Balance Sheet is the standard financial statement that presents assets, liabilities, and equity as of the end of one or more fiscal periods - showing what the company owns and owes. It is 'balanced' because the 'ownership' – the stockholders and the banks – together own exactly all of the assets. The balance sheet also identifies which assets and liabilities are current (cash will flow within one year) and which are not likely to change in that time period (fixed assets and long-term debt, such as mortgages).

Typical Balance Sheet

ASSETS		**LIABILITIES**	
Cash & Securities	31,377,349	Accounts Payable	34,179,563
Accounts Receivable	34,798,632	Other Current Liabilities	12,000,000
Inventories	14,755,694		
Other Current Assets	2,983,651		
Total Current Assets	**83,915,326**	**Total Current Liabilities**	**46,179,563**
Factory, Machinery & Equipment	109,763,552	Bank Notes	32,500,000
Less: Depreciation	(63,850,994)	Other Long Term Liabilities	
Net Fixed Assets	45,912,558		
Other Assets		**Total Liabilities**	**46,179,563**
		Paid in Capital	20,000,000
		Retained Earnings	63,648,321
		Stockholders Equity	83,648,321
Total Assets	**129,827,884**	**Total Liabilities & Equity**	**129,827,884**

Cash Flow or Funds Flow

The Cash Flow (or Funds Flow, or Sources & Uses) Statement is the standard financial statement that shows how cash was obtained and used in one or more fiscal periods. This statement is fundamental in a sound cash management program.

"When you are out of cash, you are out of business," and most companies expend significant energy to design and enforce appropriate controls with supporting metrics to ensure reliable cash flow. Cash may be borrowed or paid back, stock may be sold or repurchased, and Dividends may be paid. In addition, cash management is achieved through a number of policies and metrics associated with Accounts Receivable, Accounts Payable, and Capital Expenditures (CAPEX).

Typical Cash Flow Statement

SOURCES AND USES	
Profit After Tax	30,622,651
Depreciation	4,765,241
Changes in Receivables	75,600
Changes in Inventories	75,601
Changes in Accounts Payable	455,002
Changes in Other Assets/Liabilities	
Net Cash From/To Operations	**35,994,095**
Changes in Fixed Assets	
Sale or Purchase of a Business	
Net Cash From/To Investments	**-**
Changes in Notes Payable	
Changes in Paid-In-Capital	
Dividends	(24,000,000)
Net Cash From/To Financing	**(24,000,000)**
Net Cash Flow	**11,994,095**

NOTES:

Put Finance to Work

Key Ratios

Various ratios are computed and widely used to evaluate financial strengths and weaknesses, and trends, of a company. The ratios shown are typical, and can be characterized as Activity, Leverage/Solvency, Liquidity, Market Value, Productivity, and Profitability Ratios. Their use depends on the specific concerns of executives, managers, and shareholders. It can be misleading to use such ratios without a context, such as industry norms or period to period comparisons, and few reliable ratio benchmarks exist at levels of granularity meaningful to operating managers, but the higher level ratios in the ratio categories that follow can provide guidance.

Ratio Calculation Summary

Liquidity

Working Capital	= Current Assets - Current Liabilities
EBIT	= Pre-Tax Profit + Interest Expense
Current Ratio	= Current Assets / Current Liabilities
Acid Test	= (Current Assets - Inventories) / Current Liabilities
Free Cash Flow	= Period Cash Flow + Dividends + Interest - Tax on Interest

Activity

Days Sales Outstanding	= 365 x A/R / Revenue (Annualized)
Days of Supply	= 365 x Inventory / Cost of Goods Sold (Annualized)
Operating Cycle	= Days Sales Outstanding + Days of Supply
Inventory Turns	= Cost of Goods Sold (Annualized) / Inventory
Asset Leverage	= Revenue (Annualized) / Total Assets
Cash Flow vs Earnings	= Period Cash Flow / Period Profit After Tax

Leverage (Solvency, Long-Term Debt)

Debt Ratio	= Total Liabilities / Total Assets
Debt / Equity Ratio	= Total Liabilities / Equity
Interest Coverage	= Earnings Before Interest and Taxes (EBIT) / Interest Expense

Profitability

Gross Profit Margin	= Gross Profit / Revenue
Profit Margin	= Profit After Tax / Revenue
Pre-Tax Profit Margin	= Pre-Tax Profit / Revenue
Return on Assets	= Profit After Tax / Total Assets
Return on Invested Capital	= Profit After Tax / Equity

Market Value

Price / Earnings Ratio	= Market Value of Stock / Profit After Tax
Dividend Yield	= Dividends / Market Value of Stock
Dividend Payout	= Dividends / Profit After Tax

Productivity

Revenue / Employee	= Revenue / Internal Headcount
Profit / Employee	= Profit After Tax / Internal Headcount

Liquidity Ratios

These ratios provide insight into whether an organization can pay its bills.

- *Current Ratio*: Current Assets divided by Current Liabilities, a measure of liquidity, or the ability to pay current debts out of current assets
- *Cash Ratio*: Cash divided by current liabilities (measures the ability to pay current obligations with cash)
- *Acid Test*: (AKA Quick Ratio) An extreme version of the Current Ratio, the 'Acid Test' assumes Inventory cannot be converted to cash
- *EBITDA*: (Earnings before Interest, Taxes, Depreciation, and Amortization) is a measure commonly used by investors to understand a company's ability to incur and service debt
- *EBIT*: Pre-Tax Profit plus Interest Expense
- *Free Cash Flow:* Cash available to pay to owners and lenders, calculated by subtracting Dividends and After Tax Interest from Net Cash Flow for a period
- *Working Capital*: Capital tied up in Current Assets (such as Cash, Accounts Receivable and Inventories) less Current Liabilities (such as Accounts Payable).

Activity Ratios

These ratios can indicate whether an organization is managing its work activities with financial effectiveness and efficiency.

- *Asset Leverage*: Use of assets to gain the optimum revenue (measured as Revenue divided by Assets).
- *Cash Flow versus Earnings*: An indicator of liquidity trends, computed for a given period
- *Days Sales Outstanding (DSO)*: A measure of Accounts Receivable, measured as A/R divided by annual Revenue, times 365. DSO theoretically measures how many days we wait after delivering a product to get paid for it. In general, shorter cycles are better
- *Days of Supply*: The number of days' worth of inventory on hand, estimated on the basis of use rate. See also inventory turns, the reciprocal.
- *Operating Cycle*: The number of days from the time money is spent until it is collected, from the purchases that do into inventory to the collection of receivables

- *Operating Cycle*: The number of days from the time money is spent until it is collected, from the purchases that do into inventory to the collection of receivables
- *Inventory Turns*: (AKA Turnover) Turns measure how fast inventory is used and replaced. Different categories of inventory can turn at different rates. Computed as Total annual COGS divided by Inventory. Higher turns reduce invested capital

Leverage/Solvency Ratios

These ratios show the ability of an organization to get long-term cash from investors and banks.

- *Debt / Equity Ratio*: Total Liabilities divided by Total Equity, indicates the balance of the stakes held between owners and creditors. A ratio of 1:1 suggests lenders see acceptable risk in lending an amount equal to the owners' equity
- *Debt Ratio*: Total Liabilities divided by Total Assets, indicates how much of the company is owed to creditors
- *Interest Coverage*: Also called Cash Coverage. Ability to meet all interest obligations out of earnings
- *Times Interest Earned*: Earnings Before Interest and Taxes divided by Interest
- *Total Debt Ratio*: The ratio to total assets of all debts of all maturities to all creditors

Profitability Ratios

These are key ratios indicating how efficiently a company earns money, generally compared within an industry, since different industries exhibit very different results.

- *Gross Profit Margin*: The contribution made toward corporate expenses by the sale of products, calculated as Revenue less Cost of Goods Sold, expressed as a percentage
- *Pre-Tax Profit Margin*: Pre-Tax Profit Margin is a percentage calculated as Net Profit before Tax divided by Revenue
- *Profit Margin*: Profit Margin is a percentage calculated as Net Profit after Tax (NPAT) divided by Revenue

- *Return on Assets*: This is a measure of the efficient use of assets to gain profit (NPAT divided by Total Assets). Other ratios may be more meaningful in certain circumstances, such as Return on Controllable Assets (ROCA), meaning assets under the control of the department or organization responsible for their use
- *Return on Invested Capital (ROIC)*: This is a measure of the efficient use of assets to gain profit (NPAT divided by Equity)
- *Total Asset Turnover*: A measure of how productive assets are at generating revenue

Market Value Ratios

These are ratios of interest to the stock market.

- *Dividend Payout*: Per cent of Net Profit after Tax paid out to shareholders in the form of Dividends or Distributions (Dividends divided by NPAT)
- *Dividend Yield*: The value of Dividends paid compared to the Market Value of a stock
- *Market-To-Book Ratio*: Current price of a share of stock divided by the accounting value of that share
- *Price/Earnings (P/E) Ratio*: The value of a stock expressed as a multiple of a company's earnings, based on expectations in the industry. This ratio is widely used to measure the stock market's enthusiasm for a stock. High multiples suggest stock buyers see more value than current earnings would suggest, based on business combinations, e-commerce, business efficiency, or other factors

Productivity Ratios

This type of ratio indicates the efficiency of an organization's use of resources in gaining financial benefits.

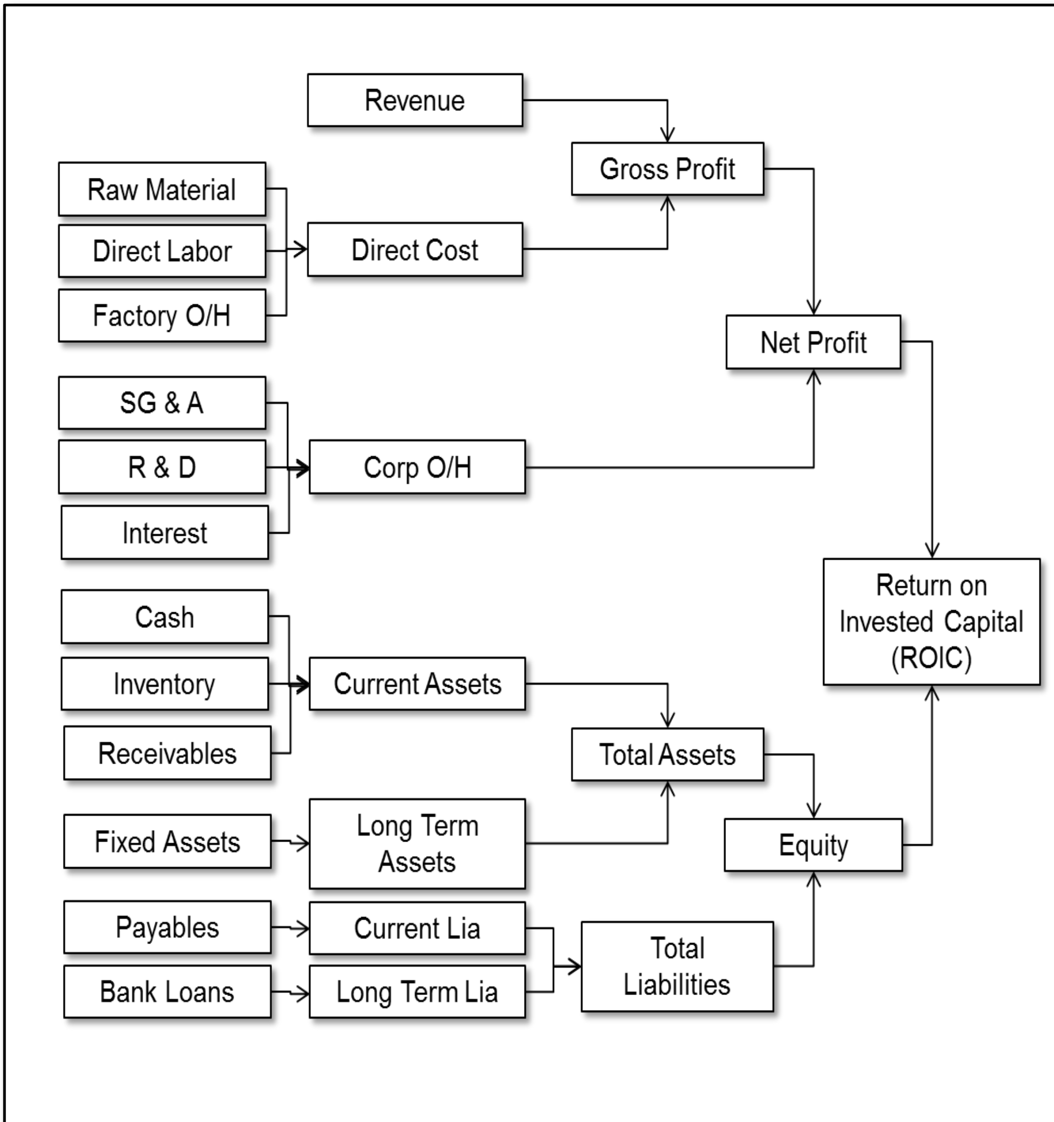
- *Profit / Revenue Per Employee*: This is a measure of the efficient use of human resources in securing profit or income for an organization
- *Asset Utilization Ratios*: Any ratios that measure how efficiently a firm uses its assets to generate sales
- *Average Accounting Return*: Defined as average net income divided by average book value

Return on Invested Capital

Return-on-Investment metrics vary widely in terms of what they measure and over what period. For example, they may look at pre-tax or after-tax profit or at cash flow returns against an out-of-pocket or otherwise measured investment, over the current year or any other appropriate time horizon.

One of the most effective metrics of this type is ROIC, measured to focus on the after-tax earnings on the average equity invested. It can be viewed for any period in the format illustrated, and provides excellent insights into how and where money is made in an organization. Its special strength comes from the viewer's ability to see instantly the effects of specific revenue, cost, and asset initiatives, and to assign accountabilities in an intuitive way.

A related metric sometimes presented in a similar format is Return on Controllable Assets (ROCA), measuring the effectiveness of managers controlling specific assets.


Revenue
Gross Profit
Raw Material
Direct Labor
Factory O/H
Direct Cost
Net Profit
SG & A
R & D
Interest
Corp O/H
Return on Invested Capital (ROIC)
Cash
Inventory
Receivables
Current Assets
Total Assets
Fixed Assets
Long Term Assets
Equity
Payables
Bank Loans
Current Lia
Long Term Lia
Total Liabilities

Net Present Value (NPV)

Elevator Pitch
"Money today is worth more than money tomorrow."

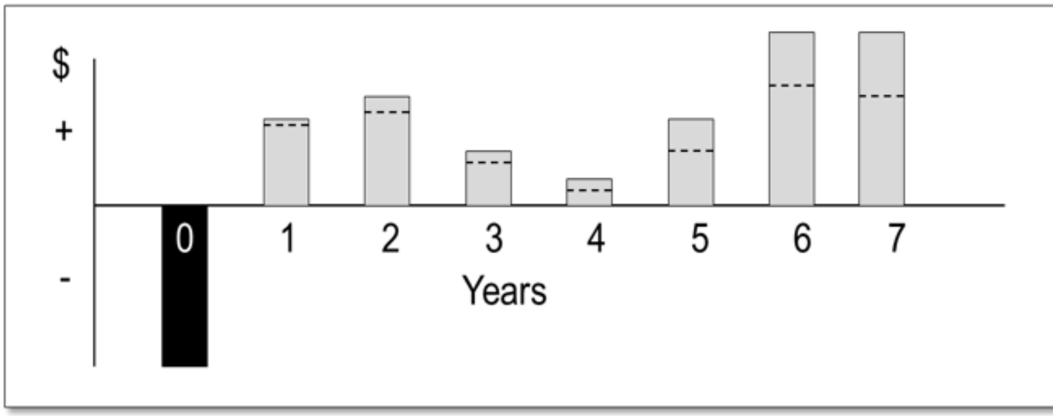
Net Present Value is a calculated estimate of the value of an investment's cash outflows and inflows over the life of the investment. It is based on the concept that money in hand at present is worth more than money in the future. Future income is 'discounted.' Bank interest reflects this reality and could be used as the discount rate – will the investment under consideration pay as much as or more than bank interest?

Many organizations set 'hurdle' rates as the discount rate for their investments. Every investment decision must apply that discount rate and indicate a positive NPV, earning more than the minimum return (for example, more than bank interest). In reality, the rates are typically significantly higher than bank interest because risks are often much higher than a savings bank.

To calculate NPV:

1. *PVIF = 1 / (1 + R) ^ t where PVIF is the Present Value Interest Factor for each period, R is the Interest Rate and t is the period (generally year 1, 2, 3, etc.). Each successive period will apply the interest rate to the prior year's reduced rate, so later money is realized, the less it is worth in the present.*
2. *PV = Amount x PVIF where PV is Present Value for each period and Amount refers to the amount to be realized in that period*
3. *Net Present Value (NPV) = Sum of (PV) for all periods*
    - *Assumes the cash is invested in the period prior to period 1.*
    - *Negative values in early periods represent investments*

Net Present Value Illustrated



In this illustration, each successive year is discounted at a higher percentage than the year before, with a significant reduction in the value of year 7.

NPV provides the cash value of an investment in today's terms but does not address whether the discount rate is appropriate nor how long cash will be tied up.

Excel has a powerful NPV calculator, but it will underestimate (discount) the value of the initial investment. To correct for this, use the NPV calculator for years 2 and subsequent, then add the first year (a negative value) to calculate NPV accurately - NPV(Cell containing Year 2 : Cell containing Year n) + Cell containing Year 1. Also, if you leave a period blank in Excel, it is assumed not included; if you enter a zero, it will be included.

Internal Rate of Return (IRR)

Internal Rate of Return refers to the rate of return calculated directly from the cash outflows and inflows of that project. This can be complex for fluctuating cash streams, but IRR can also be considered the Discount Rate at which NPV is equal to zero – the present value of all the inflows exactly equals the present value of all outflows.

IRR has the advantage of describing investment efficiency, but is not helpful in understanding an investment's size or timing.

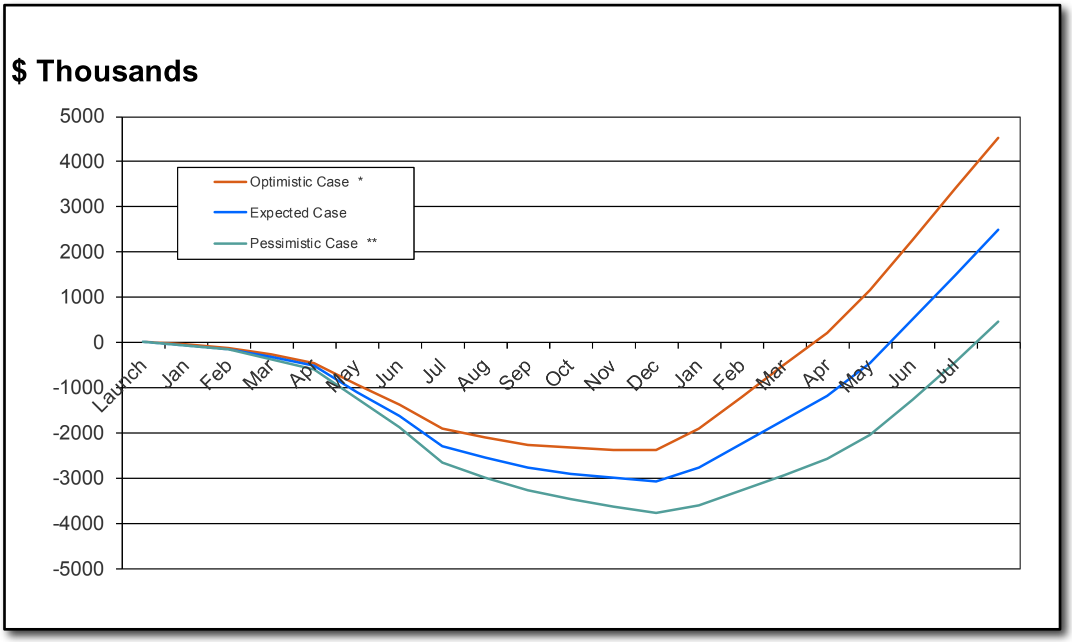
As a practical matter, it would require multiple iterations of the NPV calculation to find the rate at which NPV is zero, but fortunately Excel has a powerful built in IRR function – IRR(Cell containing Year 1 : Cell containing Year n). Note that, as for the NPV function, if you leave a period blank in Excel, it is assumed not included; if you enter a zero, it will be included.

Payback Chart

One of the key metrics investors consider before committing their funds is payback, or how long until the income covers the outgo. This can be viewed on a pre-tax or after-tax basis, or based on cash flow, and it can be viewed on a raw or discounted basis. The payback chart illustrated here is based on raw cash flow, and shows a lot more than payback. By showing the cumulative cash flow over time it provides a sense of the timing, amount, and risks, and it helps set expectations against which to measure the actual results.

<u>Elevator Pitch</u>

"Investor are generally concerned about when they will get their money back. The Payback Chart sets expectations not only for when, but about the deepest point and the attractiveness over time."

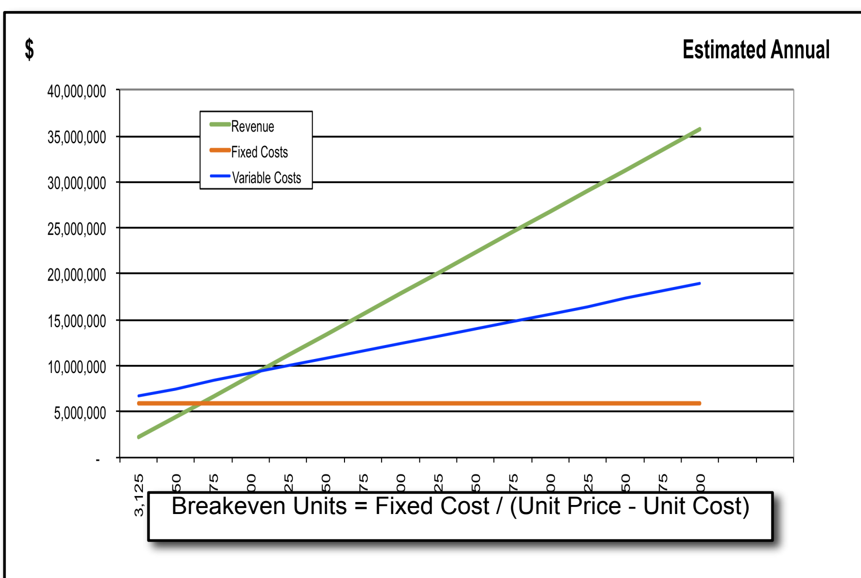


Breakeven Chart

> **Elevator Pitch**
> "For a new business or a new product, it is critical to know how many units must be sold to avoid losing money."

It is useful to know, when revenues are uncertain, exactly how much must be sold to break even (not lose money). Some costs related to each sale are Variable – they vary in direct proportion to the number of units sold. For example, the material used in each item has the same cost within a reasonable volume range (beyond that range, volume pricing breaks and other factors can impact the cost). Other costs are Fixed – unchanged by volume. For instance, factory rent is not changed for higher throughput (again up to a point –more space may be needed as significant increases occur).

Breakeven Analysis involves computation of the point at which profit contribution exactly equals the fixed costs of a company. This is usually shown on a graph and used to further estimate how much profit or loss will be experienced above and below the breakeven revenue (or volume) point.



Insourcing and Outsourcing

> **Elevator Pitch**
> "In our flat world competitors win by producing quality goods efficiently anywhere. If you can make a purchased part better (quality and efficiency) insource it. If a reliable supplier has critical mass, outsource."

In his excellent book "The World is Flat," Thomas Friedman notes that work of all types, and especially knowledge work, can be done anywhere on earth. In this world market what matters is quality and efficiency, and both are optimized in well-run organizations that have critical mass – sufficient sales volume to utilize their capacity and fund their continuous improvement programs. Insourcing (bringing work in-house that is currently performed by outside vendors) and outsourcing (finding reliable vendors to replace or supplement in-house capacity) are an important piece of the competitive equation. Each organization is challenged to regularly review its own production methods to determine, for every cost-significant product or service component of its offering:

If made in house:

- Are we utilizing our dedicated resources at least 65%? (Less would suggest we might not be at critical mass.)
- Does someone do it so much better that our cost would decrease if we bought outside? (Remember to factor in the cost of poor quality!)
- Is this a critical core competence or scarce commodity that we can't afford to lose for its significant competitive advantage?

If Purchased:

- Do we have underutilized resources that could be applied efficiently to this component?
- Can we do it well enough that our cost would decrease if we made it inside?
- Is this a critical core competence or scarce commodity that we need to better control for its significant competitive advantage?

The 'In-Outsource' Excel workbook on the available CD contains a robust tool for financial evaluation of insourcing or outsourcing work.

Price Sensitivity

Elevator Pitch

"There is an optimum price point for every product. Priced above that point, fewer customers will buy and sales volume will be degraded, driving down revenue and potentially increasing unit cost. Below that point, increased demand will not cover the revenue lost."

Price sensitivity refers to the impact on revenue and profit resulting from increasing or decreasing prices. Raising a product's price will eliminate some buyers, for perceived value or affordability reasons, while lowering the price will have the opposite effect. These economic and psychological factors must be considered when setting or resetting prices.

Any product could provide an example: could GM build enough Corvettes if they were priced at $1,000 new and fully loaded? Could the Wall Street Journal sell a daily newspaper for $100 per copy? But in fact the actual optimum point – just the right number of customers at just the right price to maximize revenue or profit – requires careful analysis.

The 'Price Sensitivity' Excel workbook on the available CD provides a starting point for considering the ideal price for any product or service.

Shareholder Value

There are many ways to measure and estimate Shareholder Value, but we offer a simple view: Shareholder value is market value of the company's stock divided by the book value of the company, representing the premium stock purchasers are willing to pay for the assets of the company under its current management.

> **Elevator Pitch**
>
> "Shareholder Value can be measured by the premium over book value that people will pay to own a company's stock."

This model is based on a series of managed leverages, multiplied together, indicating how well the operating team sells and produces for a profit, how well the executive team deploys assets to drive revenue, how well the financial team uses borrowed money to gain financial leverage, and how well the CEO and PR team sell the company to the equity markets.

Operating Leverage		Asset Leverage		Financial Leverage		Market Leverage		Shareholder Value
0.13	x	1.60	x	3.41	x	9.33	=	6.36

Profit After Tax		Revenue		Assets		Market Value		Market Value
1,500		12,000		7,500		14,000		14,000
———	x	———	x	———	x	———	=	———
Revenue		Assets		Book Value		Profit After Tax		Book Value
12,000		7,500		2,200		1,500		2,200

Executive Highlights

Executives are apt to ask for nearly any format of any analysis outcome, for decision making or for reports to shareholders, but a few reports are most commonly used, and highlights are typically drawn from them, as in the example below. The reports are:

- Profit & Loss Statement (P&L), showing income, costs and profits or losses by month, quarter, or year.
- Balance Sheet, showing all assets, liabilities, and equity by month, quarter, or year.
- Cash Flow Statement, showing the sources and uses of cash by month, quarter, or year.
- Payback Curve, showing the cumulative inflows and outflows of cash by month in the best, worst, and expected cases. This report often includes Net Present Value (NPV) and Internal Rate of Return (IRR).
- Return on Invested Capital breaks down costs and assets for easy analysis of the efficiency of asset use for any month, quarter, or year period.
- Key Ratios shows some commonly calculated ratios used by accountants to assess the health of a company for any month, quarter, or year period.

Breakeven Chart shows the dynamics of profitability for any month, quarter, or year period.

Typical Executive Summary

Financial Highlights

$ Thousands
For the Fiscal Year Ending June 30

Racing Division
Expected Case

	2007	2008	2009	2010	2011	Total
Revenue	1,000	1,050	1,103	1,158	1,216	5,526
Gross Margin	510	540	572	605	639	2,865
Profit After Tax	240	261	278	285	321	1,384
Margin	24.0%	24.9%	25.2%	24.6%	26.4%	25.1%
Total Assets	645	832	1,036	1,222	1,443	1,443
Total Liabilities	130	131	132	133	134	134
Invested Capital	-	-	-	-	-	-
Return on Invested Capital	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Net Cash Flow	209	199	168	202	237	1,015
Cumulative Cash Flow	209	408	577	778	1,015	

Executives focus on a bigger picture, uncluttered by details. Aspiring young managers do well to learn this lesson early, to align their own thinking with executive thinking, and to avoid presenting complex charts full of numbers to their executive teams.

Activity Based Costing (ABC)

Elevator Pitch

"Activity Based Costing attempts to assign costs, currently allocated, directly to the activities that drive them."

Activity Based Costing (ABC) is applied when management suspects some products or customers cost more than they are worth due to customization or special handling. This problem is applicable especially to companies that use highly-allocated cost accounting methods, offer a wide variety of product configurations, and are excessively customer-driven. In such companies, special orders may drive hidden costs in marketing, engineering, production, or other departments, chewing up time and materials that may not even be in the 'Cost of Goods Sold' buckets. ABC methods attempt to track and recover some of these losses.

The analysis begins with an estimate of cost based on accounting data, such as the simple illustration on the next page. (It is seldom this simple in real life.) The actual costs incurred for each unit might be different from this standard cost for any number of reasons. In the example illustrated, customization requires varying

Step-by-Step

1. Calculate unit cost from the accounting system.
2. List the main activities that drive cost, and look especially for activities that are significant cost drivers and selectively supplied to products or services.
3. Determine the units of measure and rates for the drivers.
4. Develop a database of products by customer and determine how much of the special activity was applied to each unit sold.
5. Subtract the costs from the selling price for each sale to determine its profit.
6. Sort the products and / or the customers by profit in descending order.
7. Chart each list and analyze it for gains and losses, as illustrated on a later worksheet.

amounts of engineering and assembly labor, and is further complicated by varying materials cost.

In this simple illustration we recorded the actual hours of engineering, assembly and materials for each of the 20 customers listed, to determine whether each sale is producing a prodit or a loss. This chart is then sorted from most profitable to least profitable and graphed for intuitive analysis (see page 185).

In cases with many high volume products sold repeatedly to many customers, this approach is used to determine which products and which customers should be repriced or dropped.

Process: Production	Rates			
Activity: Customization	Engineering Hour	38.50	Accounting Cost	List Price
Output: Widget	Assembly Hour	14.95	1,168.57	1,200.00

Individual Unit Sold to Customer	Hours Engineer	Hours Assemble	Materials	Allocate Overhead	Total Cost	Less (More) Cost Than Accounting	Profit
A	15.00	13.20	275	180	1,229.84	- 61.27	- 29.84
B	13.50	10.00	300	180	1,149.25	19.32	50.75
C	12.25	14.00	318	180	1,178.93	- 10.36	21.08
D	9.75	12.00	295	180	1,029.78	138.80	170.23
E	5.50	12.00	345	180	916.15	252.42	283.85
F	14.00	11.50	256	180	1,146.93	21.65	53.08
G	19.25	16.00	335	180	1,495.33	- 326.76	- 295.33
H	11.00	14.00	306	180	1,118.80	49.77	81.20
I	16.00	12.00	275	180	1,250.40	- 81.83	- 50.40
J	14.50	12.00	315	180	1,232.65	- 64.08	- 32.65
K	10.00	15.50	340	180	1,136.73	31.85	63.28
L	16.25	9.25	295	180	1,238.91	- 70.34	- 38.91
M	10.75	14.25	325	180	1,131.91	36.66	68.09
N	14.00	15.00	330	180	1,273.25	- 104.68	- 73.25
O	21.00	10.50	400	180	1,545.48	- 376.91	- 345.48
P	16.00	16.25	225	180	1,263.94	- 95.37	- 63.94
Q	15.50	13.00	300	180	1,271.10	- 102.53	- 71.10
R	12.00	12.50	320	180	1,148.88	19.69	51.13
S	11.25	10.00	290	180	1,052.63	115.95	147.38
T	13.00	14.00	330	180	1,219.80	- 51.23	- 19.80

What ABC Tells Us

Elevator Pitch
"The ABC 'whale' curve can be a real eye-opener, intuitively suggesting products to kill or re-price or customers to drop or charge more."

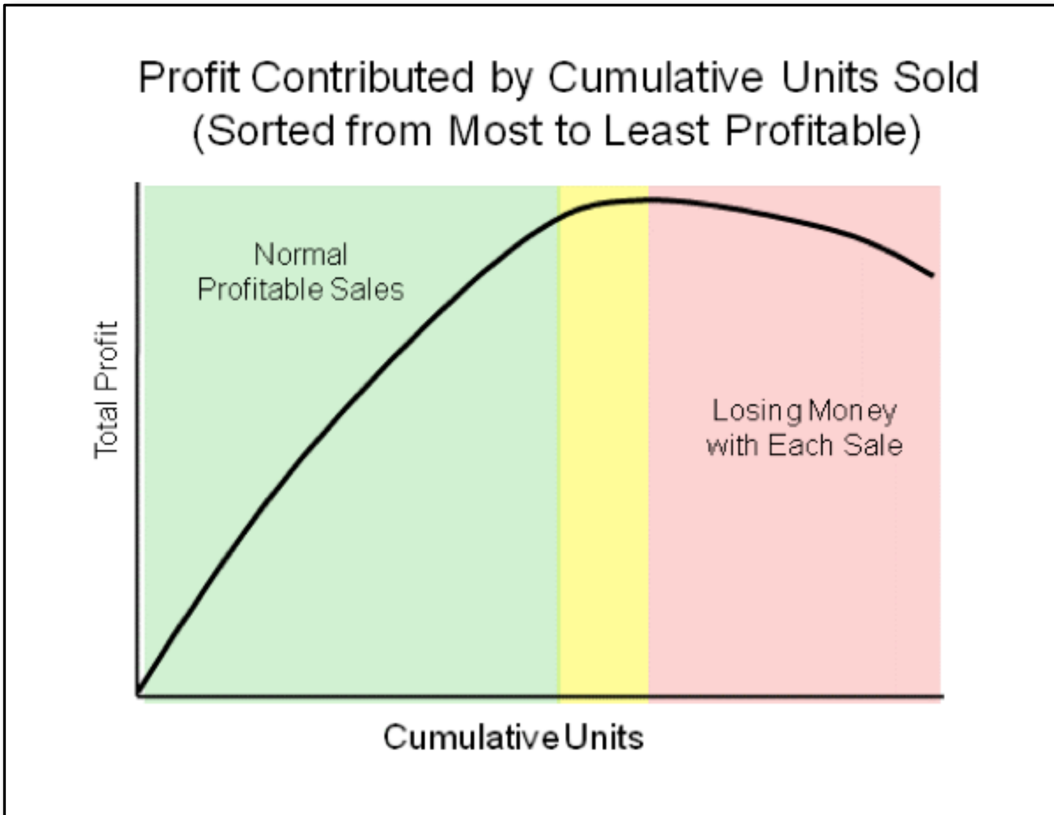
The chart on the next page represents the cumulative profitability of a large number of customer sales, and is not based on the 20 points of data in the example on the previous page (though they, too, could be charted in this way). The chart illustrates a phenomenon often found in real companies: most customer sales provide incremental profit, but some are more profitable than others (and some require so much selling effort or customization that they actually lose money). If the chart were based on a broad line of products rather than on a large number of customers, the same phenomenon might occur - most products make money, but some may actually lose it.

Analyzing the chart, and the list of customers (or products) that it illustrates, we see that there is a point (somewhere in the central yellow area) beyond which we should consider the customers (or products) problematic. There are four common options:

1. Selectively kill products or do not sell to customers that erode profits.
2. Selectively raise prices to cover the cost. If the customer agrees to pay, there is obviously perceived value. If not, at least the losses are prevented.
3. Consider the lost profit a marketing investment and watch it closely. It may be a small loss compared to the customer loyalty or selling opportunities it provides.

Consider the loss necessary to absorb overhead costs if those costs are significant. Note that this chart illustrates 'profitability,' which could be at the gross profit or net profit level. If cost absorption is an issue, it may make sense to do an

Typical ABC Analysis Result



NOTES:

Make the Business Case for Change

About the Business Case

A Business Case estimates the financial benefits supporting any investment, such as equipment installations, business acquisitions, focused Six Sigma projects, broad Lean Production Culture projects, or any other initiatives aimed at improving business process efficiency.

In process improvement projects particularly, benefits and investments can be difficult to estimate. Benefits are especially subject to uncertainty: Will the improved process really work as well as expected? Investments are generally easier to forecast, as they may be based on contracts, but even this level of assurance can be impacted by vendor underperformance or unforeseen internal resistance or ineffectiveness.

<u>Elevator Pitch</u>

"In any change program, the Financial Business Case is essential to determine the value of the investment and to keep everyone focused throughout the implementation."

<u>Step-by-Step</u>

Use the Business Case worksheet on the available CD to develop a robust and credible financial case for your action plan. The Excel workbook calculator guides you to enter your estimates of the benefits and investments using simple formats, and the entries will be used to calculate the financial impact for up to five years by month. The results are then summarized for executive presentation, showing a payback curve, Net Present Value, and Internal Rate of Return. The calculator contains pre-loaded data as an example, which you will want to delete before loading your data.

Benefits Case

The first question to ask of any project is, “what will the benefits be?” Benefits can fall into many categories, such as increased customer or employee satisfaction, social value, and financial. In this book we are primarily focused on the financial impacts, on what is affordable and what promises to return more than it costs.

Promises are easy to make, and unsupported enthusiasm common among people with pet projects. Every benefit estimated needs to be carefully vetted (but not to the point of analysis paralysis). Financial benefits may include:

- New or enhanced revenue
- Lower cost of goods (labor, material, or factory efficiency improvements)
- ower corporate overhead
- Better asset utilization (for example, improved inventory turns) providing one-time balance sheet improvements

Cost Considerations

Costs are often more reliably estimated and more controllable than expected benefits, but still leave plenty of room for judgment. Again, people with pet projects are often too optimistic about what it will take – remember Boston's 'Big Dig?' In a business improvement project, costs are likely to include:

- The time of people whose work will need to be done by others
- Costs of internal and external experts / consultants
- Any equipment required

One should also consider 'Opportunity Cost' – the cost of NOT gaining an alternative financial benefit of an investment. For example, if an owned asset or resource is applied to project A, it will not be available for an alternative project B. The opportunity cost associated with project A is the value of the asset or resource if it were applied to project B. Opportunity costs should be entered as investments.

It is also important to recognize 'sunk' costs – costs already incurred (paid or obligated), and therefore not relevant to an investment decision.

The Base Case

Elevator Pitch

"Establish the 'Base Case' early in an analysis and keep the team focused on areas where the money is."

Step-by-Step

1. Collect P&Ls and Balance Sheets
   a. Typically past 3 years by quarter
   b. Level of granularity associated with the analysis scope
2. Secure executive agreement on trends and future prospects
3. Develop an agreed set of future statements (minimum next year, best for 3 to 5 years)
4. Create pie charts and sub-charts showing percentages and actual amounts in each area
5. Establish targets by asking the team questions such as "can we reduce admin by 10%?"

Because business improvements cost money, one of the key factors in prioritizing improvements is affordability and financial return – start with focus on where the money is. For this reason, It is useful to analyze the financial landscape before developing a diagnostic plan and committing resources to expensive research.

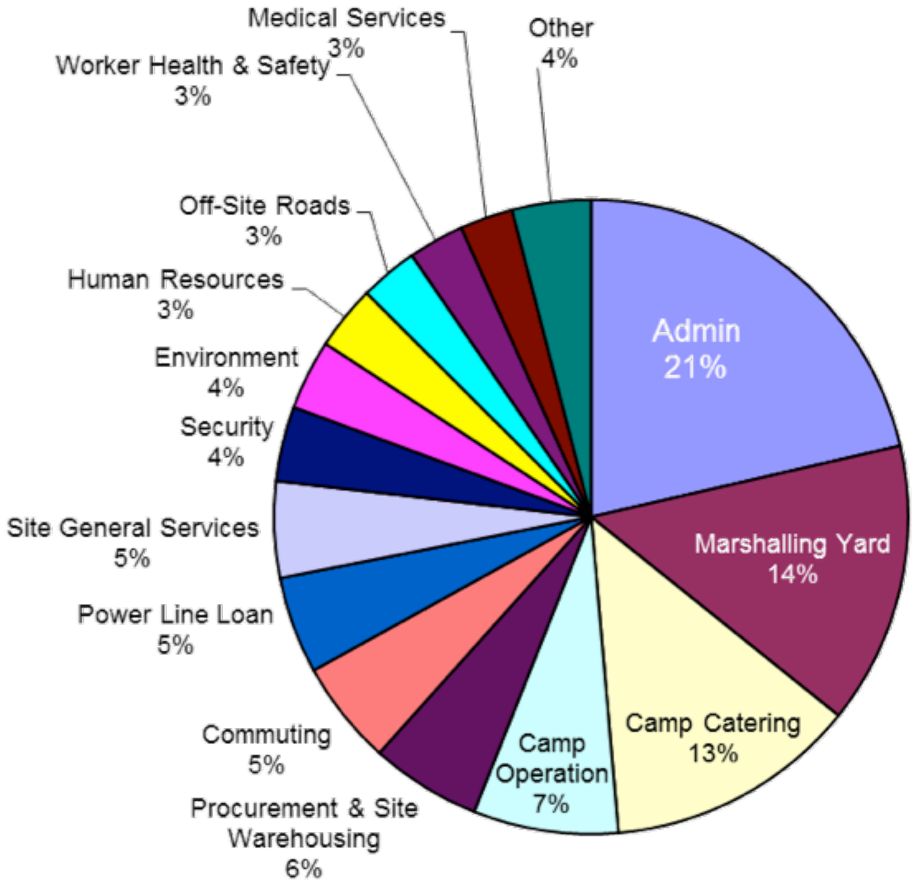
Improvements are likely to impact finances in one of four positive ways:

1. Increased revenue
2. Decreased Cost of Goods Sold
3. Decreased corporate overhead
4. Decreased asset requirements (with associated period expenses such as depreciation and carrying costs)

Offset by investments in:

1. Added corporate overhead spending (on people who do the work, for instance)
2. Added assets (machinery, equipment, software and the like) with associated period expenses such as depreciation and carrying costs)

Here is an example of a financial analysis chart created to help an analysis team focus:



In this example (a gold mining camp) the search for inefficiency might start in the admin or marshaling yard areas, with collectively over a third of the expenses. Some areas, such as Worker Health & Safety, might be considered untouchable. The pie chart provides a useful graphic for such discussions.

Opportunity Charts

Elevator Pitch

"You can't start improving anything until people agree it is broken, fixable, and worth it."

Step-by-Step

1. Use a format such as the example shown on the facing page or that on the available CD (in the 'Opportunity ID' file)
2. Train the team to use the Opportunity Chart
3. Continuously apply financial analysis to each chart, asking
   a. Accurate data?
   b. Sound logic?
   c. Solid documentation?
4. Link the business case directly to the charts to ensure understanding and agreement

As an analysis team investigates an operation, it is important to keep a degree of their focus on the potential financial impacts of their findings. This is supported by 'Opportunity Charts' such as that illustrated below. These are integral to an iterative series of 'findings' presentations early in an analysis, in which decision makers vet the team's observations and conclusions, and continuously redirect the investigations.

Opportunity charts must be supported by adequately thorough and unimpeachably accurate data, sound logic linking suggested actions with the financial estimates created, and clear documentation of these. There will be no improvement actions until the decision makers are agreed that the information in the Opportunity Charts is compelling.

Improvement Opportunity:

Project ______

Process Owner ______

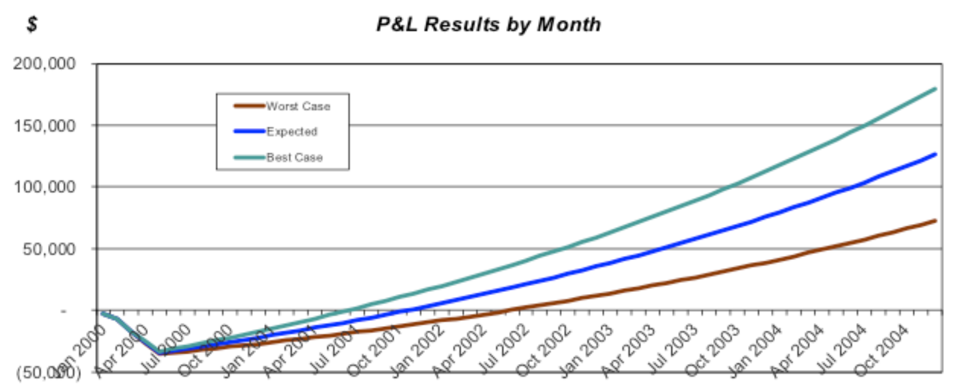
Team Member ______

Current State	Action Plan	Future State
Problem Statement	**Methodology**	**Description**
What is the problem? What are the symptoms? What are the probable root causes?	What can be done to improve the situation?	What will be different? How will it be better? (Financial and non-financial)
Baseline Metrics	**Investments and Risks**	**Improvement**
What resources are being expended? •Material costs •Machine time •People time •Inventory •Other	What resources are required? •Improvement team •Machinery & equipment additions •Information technology additions •New operating costs – people, machines, etc. When will the investments be made?	What resources will be saved? •Material costs •Machine time •People time •Inventory •Other When will these savings show up? How long will they last?

Business Case Presentation

This illustration shows a summary chart and information highlights for a typical Business Case analysis. The content can vary, but a complete analysis should include:

- Cash Flow Payback Curve showing high, expected, and low cases for two years by month
- Five year summary of expected case benefits, investments and net impact
- Internal Rate of Return (IRR) and Net Present Value (NPV)



Plan	2000	2001	2002	2003	2004	Total
Worst Case Benefits	10,171	17,279	21,578	27,031	33,947	110,006
Best Case Benefits	20,134	33,932	42,532	53,437	67,268	217,304
Investments	(37,500)	-	-	-	-	(37,500)
Worst Case Net Impac	(27,329)	17,279	21,578	27,031	33,947	72,506
Mid Case	(22,347)	25,606	32,055	40,234	50,608	126,155
Best Case Net Impact	(17,366)	33,932	42,532	53,437	67,268	179,804
IRR	Worst Case	-22%	-3%			46%
	Mid Case	-16%	1%			69%
	Best Case	-12%	3%			89%
NPV @ 10%	Worst Case	(26,915)	(12,117)			45,146
	Mid Case	(22,260)	(330)			84,903
	Best Case	(17,604)	11,457			124,660
Cumulative Payback		0.4 to 1	1.3 to 1			2.9 to 1

Features of the Excel workbook on the available CD include:

- A check box makes it easy to see the difference between P&L and Cash Flow effects.
- Slide bars allow easy evaluation of different rates for carrying costs (financial cost of owning assets such as inventory), tax rates, and discount (investment hurdle).
- A final slide bar sets the first year, for user-friendly set up.

Business Case Variables

Elevator Pitch

"There are a lot of 'what if?' questions asked when financial decisions are made, and a flexible tool can help ensure timely and accurate answers."

A business case is created for only one purpose: decision making, either GO-NO-GO for the project, or actions required to stay on course during implementation. The case is not likely to be static over time, so it is useful to use a flexible tool (such as that on the available CD) in order to answer executive and project team 'what if?' questions quickly and accurately. For this reason, the available CD business case tool has presentation page controls for several commonly switched variables:

Payback and Sensitivity Cases

Sensitivity tests help analysts visualize what might happen if an investment under or over performs, and to develop contingency plans. Typical sensitivity analysis considers a worst case scenario, to ensure business viability is not threatened, and a best case scenario, to set stretch goals for the team that will deliver the results. In the best case, revenues and liabilities are considered at their highest to be reasonably expected, while costs and assets are at their lowest. In the worst case, the Revenues and liabilities are lowest and the costs and assets are highest.

In the payback curve in the available CD file, sensitivity is represented by three lines. The top (green) line is the best case scenario, the bottom (red) line is worst case scenario, and the center (blue) line is the expected case.

Carrying Cost

Carrying Cost generally refers to the costs of 'carrying' (holding) inventory. It includes the financial costs of (i.e., interest on) cash that is invested in inventory plus typical warehousing costs such as space rent, equipment operation, and people who manage the warehouse and move and track inventories.

Discount Rate

The rate of interest assumed to represent the current cost of money. The future cash stream is ‘discounted’ at this rate to determine its value at any given future period. See also Net Present Value.

An organization's ‘hurdle rate’ is the minimum rate of return (discount rate) required of all investments. If the estimated return falls below that rate, the investment will be rejected.

NOTES:

Make Them Care with Metrics

What Metrics is All About

Metrics provide the information needed to achieve and maintain effectiveness, indicating what executives, owners, and managers care about. When they are aligned with the business vision they help ensure customers get what they need when they want it, that the company makes money, that employees are motivated and loyal, and that production of goods or services remains effective and efficient.

Elevator Pitch

"What you measure determines what you will achieve."

In too many cases metrics simply evolve based on one requirement after another. The misaligned metrics then help drive sub-optimization, unhealthy competition for resources, political maneuvering, duplication of effort, and a variety of other wasteful conditions that rob managers of sleep and shareholders of profits.

This chapter is a quick primer and a reference for creating a highly effective, balanced set of metrics in any organization, containing concepts and examples indicative of the thought process behind an effective metric system. There is a wealth of published information about balanced score cards (e.g., from Kaplan and Norton) and lean accounting (e.g., from Maskell and others) to supplement the topics covered.

Strategic Metrics

Integrating production metrics into a broad family of business metrics can help in decision-making throughout a company. Organizations typically develop measurement systems piecemeal, to resolve problems as they occur. The problem with this approach is that it fosters sub-optimization and conflict among managers attempting to drive their piece of the business without comprehending the impact on other areas. For example, the financial team may want to cut inventory while the marketing team attempts to build it.

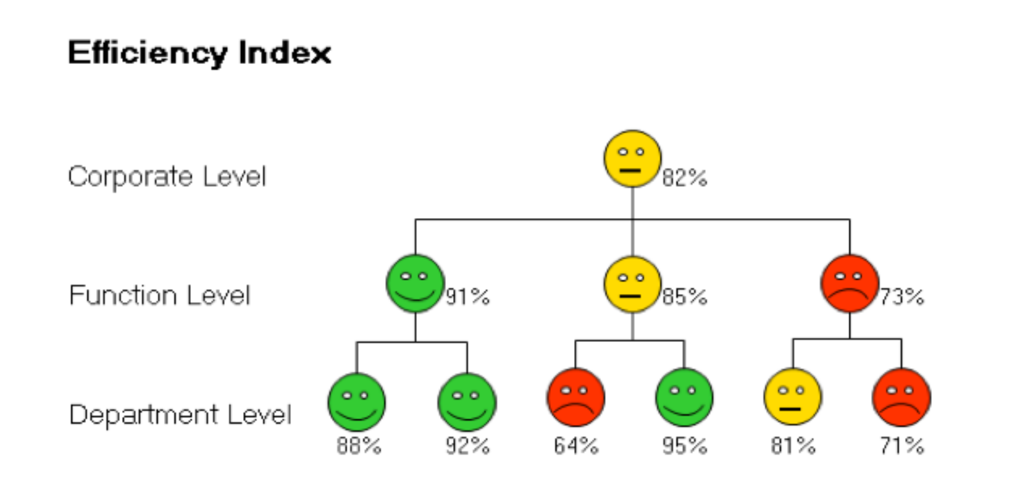
An interesting visual approach to grasp the impact is to place many of an organization's performance charts onto a single chart. Typically this will result in a confusing array with too many metrics, and with few measurement results tracking well with other measurement results.

<u>Step-by-Step</u>

In creating a measurement system, consider:

- What are the most important measures, meaning those that reflect the overall success of the business? These should include customer satisfiers, efficiency indicators, and employee satisfiers to ensure an organization's long-term effectiveness.
- What functions or departments impact these measures?
- Can the metrics be combined mathematically (as in the example shown) or will they need to be combined into a weighted index?

An effective system of key metrics will provide a view that makes sense top to bottom, side to side in an organization. The most important indicators will be clearly visible at the top of the organization, as an index or a combined value, and it will be easy to investigate successive lower levels to identify the sources of problems.



Hierarchy of Metrics

An effective system of metrics has several characteristics:

- It fosters a balanced view, preventing sub-optimization among departments and helping to resolve conflicts between functions or departments.
- It recognizes the role of processes in accomplishing work, and fosters immediate resolution of process issues by operators in the area affected.
- It is hierarchical. Indicators at the highest level can be peeled back to the lowest level with no loss of directional integrity.
- It is minimalist. There are no unnecessary metrics to generate information overload. Metrics are for communication and decision-making - only.
- The mathematics are simple. Wherever possible, it is better to simply add department results than to create complex algorithms that confuse managers and executives.
- It is as visible side-to-side and top-to-bottom as is prudent. The more people can know about the metric structure and actual performance, the better they will understand what drives the business and the better their decisions will be.

The structure suggested on the next page is merely a starting point, but includes some of the most common elements needed to support decision-making.

Sample Hierarchy of Metrics

Chief Executive Focus

- Financial statements and key ratios
- Customer satisfaction index
- Employee satisfaction index
- Production effectiveness index

Customers

- Profitability by customer
- Sales funnel
- Time to market
- Order to delivery
- Price competitiveness
- Customer satisfaction

Financial

- Profitability by product, product line, and customer
- Return on assets (by operating unit)
- Budget variances

Employees

- Employee satisfaction
- Retention
- Wage / salary structure (versus the industry)
- Training investments
- Skills (survey)
- Union grievances / act

Production (Strategic Indicators)

- Quality Index
- On time delivery index
- Continuous improvement progress
- Inventory turns

Plant Work Cells (Daily)

- Throughput
- Cycle time - production / total
- First pass yield
- Error rate
- Cost of quality
- vertime
- Machine utilization
- Changeover time
- Daily schedule attainment
- Unscheduled downtime pareto o Raw, WIP, and Finished Goods inventories
- Kanban integrity

Balanced Scorecard

Elevator Pitch
"The Balanced Scorecard ensures that executives and managers are setting objectives that consider financial, customer employee, operational and community/ ethical requirements."

The concept of the 'Balanced Scorecard' was introduced in 1993 by Harvard Business School professors Robert Kaplan and David Norton. Like the hierarchy of metrics on the prior pages, it is designed to ensure top management focus on the trade-offs required to achieve interrelated strategic objectives and avoid sub-optimization.

Particular focus is on preventing financial measures from overshadowing other important considerations such as investments for the future, customer and employee satisfaction, ethics, community relations and the like.

The Balanced Scorecard can be used to establish specific targets and accountabilities. For example:

OBJECTIVES	TARGETS	ACCOUNTABLE
Financial 1. ROIC 2. Profit margin 3. Etc.		
Customers 1. Satisfaction Index 2. Etc.		
Employees 1. Satisfaction Index 2. Etc.		
Processes 1. Quality 2. Efficiency 3. Etc.		
Community 1. Philanthropy 2. Etc.		

Other columns could address achievement dates, associated projects / teams, and similar information to support achieving key objectives.

Lean versus Traditional Metrics

Elevator Pitch

"Lean Accounting turns the accounting team loose to focus on business improvements that drive profit."

Lean metrics are best viewed in the context of lean accounting. The key insights of lean accounting are illustrated in this chart in terms of significant contrasts with traditional accounting.

In traditional, full-absorption accounting, a primary task of accountants is to fix specific costs to every produced item. The costs are typically captured and tracked in units of raw, Work-in-Process (WIP), and finished goods inventories, and become Cost of Goods Sold (COGS) on the Profit and Loss Statement (P&L) as each unit is bought by a customer. Numerous transactions are processed daily to ensure that costs of materials and direct labor are assigned correctly and that production overhead costs are allocated as accurately as possible. That can be a lot of accounting.

By contrast, Lean Accounting focuses on all costs of 'value streams' (start-to-finish work activities associated with individual product families). Because inventories are virtually eliminated or held very stable by in-line kanban rules, costs are streamlined and no longer tracked into and out of inventory. Work cells measure actual WIP versus Standard WIP (SWIP) on an ongoing basis, and over and under conditions receive immediate self-correction at the point of creation. SWIP will be adjusted based on overall plant throughput as volumes rise or fall, and Balance Sheet adjustments can generally be made on an infrequent as-needed basis. In general, the more variety of product and process, the more often lines are stopped and started, the more a company can profit from Lean Operations. Simultaneously, the more a company gains by shifting to Lean Operations, the more it will gain from also shifting to Lean Accounting.

This work reduction frees accountants up for the productive work of helping company strategists focus on uses for available capacity (which typically increases dramatically in a lean environment) and helping line operators identify, prioritize, and capitalize on cost opportunities. Lean Accounting is not less accounting, but it provides a lot more bang for the buck.

Lean vs Traditional Accounting

Traditional	Lean
o Accounting data drives production decisions	o Production decisions are made based on immediate production metrics
o Every machine needs to run as efficiently as possible - usually by running non-stop	o The overall process is run as efficiently as possible. It's okay for a machine to sit idle when not needed
o Errors are found by inspection and may be blamed on operators	o Errors are assumed to spring from interconnected processes and are resolved at their roots
o Value is tracked in inventories as they work through the production steps, driving continuous, complex calculations	o Cost is tracked at the value stream level. Inventory is calculated based on period throughput and adjusted only as throughput changes

Process versus Results Metrics

Metrics fall into two classes: Process (leading indicators) and Results (historical records). Both are critical to business effectiveness and continuous improvement of business operations.

Process metrics are used on the front lines to ensure the overall machinery of the operation stays in tune. They indicate that immediate action needs to be taken by the operators and supervisors, adjusting equipment, directing resources, or correcting operators or procedures. They also indicate when longer-term fixes are needed, identifying opportunities to be addressed in Kaizen Events, policy or engineering change requests, etc., under the continuous improvement rubric. These metrics are further used as key analytical input in addressing issues.

Process o Predictive,future-oriented o Early warning o Day-to-day o For operating decisions	***Results*** o Historical o Longer-term view o Periodic (Quarter,Year) o For strategic decisions
Examples o Statistical quality o Daily throughput o First pass yield o On time delivery	***Examples*** o Financial Statements o Cost & profit analyses o Customer Sat Survey o Employee Sat Survey

Results metrics are used by executive management to formulate strategies and institute policies and guidelines for operations. Financial information indicates how well investments are performing and informs further investment and financing decisions. Customer satisfaction data helps establish marketing and sales strategies and resource allocations. Employee satisfaction and comparative salary data helps set hiring, training, rewards and recognition, and firing plans and policies.

Process metrics, rolled up and accumulated over time, also help executives in establishing manufacturing policy and strategy, and are especially useful in support of continuous improvement.

Customer Metrics

Philip Crosby defines quality as conformance to requirements, with primary emphasis on customer requirements. This implies that market survival and growth in an increasingly quality-conscious environment are fueled by knowledge of customer needs and wants, and require metrics that ensure alignment. The chart illustrates the kind of metrics that inform product and service decisions.

What customers value	What to measure
Unique designs	Changeover / available operating time at plant
Time to market	Concept to production cycle
Ruggedness, appearance	o First time quality o Life time quality o PPM
Availability	o Order to promise o On time delivery
Price	Index to competition o At the dealer o To the trade
Attention and customer service	Customer satisfaction

Note particularly that customers generally want personalized service, and to be treated as valued, important business partners. Relationship selling has been impacted by the Internet and the expectation of 'getting a deal,' but people still buy, when they can, from people they know and trust. If you want customer loyalty, never lose sight of how customers perceive your relationship with them. Metrics can help.

It is important to recognize, of course, that customer loyalty needs to be traded off with profitability. There are significant differences between being ‘customer driven’ and ‘customer compelled,’ and the metrics suggested along with benchmarks (comparisons with the offerings of other companies) can help identify the boundaries in your industry.

Financial Metrics

Financial metrics are fairly standard across industries, but often misused, even in the rigidly controlled environment created by Sarbanes-Oxley. Some of the common misapplications include:

- CEOs, and headquarters organizations, sometimes review results and dictate cost cuts (often necessary) without considering whether their divisions or plants have the tools and skills to deliver without seriously damaging the business.
- Executive teams are often too focused on the short term.
- Subsidiary elements are sometimes required to report information at levels so low that headquarters organizations couldn't possibly analyze it properly. Any resulting headquarters micro-management can only confuse and demoralize operators and misapply resources.
- Weak financial direction can confound decision-making with shifting investment methodologies and criteria.

What stockholders value	What to measure
Return on assets	Profit after tax / assigned assets
Product management	Profitability by product or product line
Utilization of resources	Profit per employee
Investment management	Business cases Results tracking

Financial metrics should be recognized for the trailing indicators they are, valuable for strategic direction setting but less useful for tactical decisions.

Employee Metrics

Employees on the front lines accomplish the vast majority of the work of a company, and are rightly considered the most important resources in enlightened organizations. The overwhelming majority of workers want to create value efficiently to protect their income, their retirement options, and their pride of workmanship. For this reason they are generally delighted at the opportunity to participate in improving product quality and process efficiency, and to provide a fair output for their fair salaries and wages.

What employees value	What to measure
o Fair wages / salaries o Interesting work o Advancement opportunity o Pleasant working conditions	o Employee satisfaction o Retention o Wage / salary structure versus the industry o Training investments o Skills (survey) o Union grievances / actions

Metrics help an organization know what they must pay to get skilled people and how employees see the environment created. Training programs are created and revised to ensure people are getting what they need, and metrics identify the gaps. Critical skills and succession planning are directly influenced by meaningful skills and retention data, exit interviews, and surveys. In most organizations, executive and managerial effectiveness depends directly on knowing their employees very, very well.

Production Metrics

Production is a minute-by-minute phenomenon, and process metrics can help make near-instantaneous adjustments to prevent any substantial problematic output. When operating teams have immediate awareness of out-of-spec products, they can adjust equipment, focus skills, escalate the problem for higher level review, or stop production as needed to prevent increasingly expensive downstream problems.

Lean operations - relentlessly reducing waste - depend on meaningful, accurate measurement of every critical production parameter. This chart illustrates some useful performance measurement concepts. Your operations may have additional parameters to measure, beyond the effectiveness, efficiency, schedule, and inventory considerations illustrated, but this is a good starting point.

What the Process Needs	What to measure
o Production effectiveness	o Throughput o Cycle time - production / total o First pass yield o Error rate o Cost of quality
o Production efficiency (Minimum wasted time / resources)	o Overtime o Machine utilization o Changeover time
o Schedule integrity	o Daily schedule attainment o Unscheduled downtime pareto
o Minimum inventory	o Raw, WIP, and Finished Goods inventories o Kanban integrity

Metrics Terminology

Metrics typically fall into the categories discussed above, but with many variations of emphasis and terminology. For example, metrics for ‘production’ or ‘customers’ in a hospital will use industry-specific terms unfamiliar in a bank or a manufacturing facility. The terminology is important, for rapid and clear communication in a given environment, and professionals must learn the native language of their chosen field thoroughly and quickly to be successful.

Benchmarking

Metrics are a logical starting point for benchmarking and for identifying best practices. The chart illustrates a logical sequence and some key considerations for an organization adopting a benchmarking philosophy.

But however popular, benchmarking is a commonly misunderstood concept. Some executives appear to believe that their organization's efficiency and effectiveness can be controlled by fiat, and that simply informing employees about demonstrated better performance will generate improvements. However, benchmarks and best practices can be misleading, and employees will be demoralized if they see no path to their goals.

- Business is seldom done the same way by any two companies, however similar their products and markets. For example, one company may rely on an ERP system for its information backbone, while another may for legitimate reasons handle its transactions more manually, resulting in very different overhead cost structures.

- Best practices may not be appropriate. ‘Good enough’ may be good enough. For example, a manufacturing organization typically does not need to process its transactions as fast or efficiently as a financial institution, even though with enough investment it could.

- Benchmark databases vary in quality, depending on the insights and purposes of the organization that created them and on the survey instruments and populations used to generate them.

Despite these concerns, benchmarks can be useful as all the bars in business are continuously raised. The key is to track the right indicators and to

Considering Benchmarking?

Establishing	Ensure that...
1. Ensure that your metrics are measuring the things that matter to your business 2. Findtheorganizationsthatkeep databases of measures for the industry you are in 3. Review prospective databases before buying for: - Comparability to your operations - Useful focus / trend information - Best practice identification 4. Train an internal team to analyze and interpret data for goal setting 5. Develop benchmarking	o Benchmarks are kept current as part of an overall business intelligence activity by dedicated internal assignments o Goals based on benchmarks are: - Appropriate, prioritized for meaningful business impact - Achievable. If they are a stretch, ensure the tools and road map to achieve them are available. o Any partnerships are nourished (and remain justified) through the exchange of useful, high-quality data

NOTES:

Stop Boiling the Ocean

About the Initiatives Review

Many organizations try to ‘boil the ocean,’ working on many improvement initiatives simultaneously, investing considerable time and resources without coordination or prioritization. This chapter contains simple formats for investigating who is doing what, where and why in order to help executives focus the resources of the organization on the improvements that will really count.

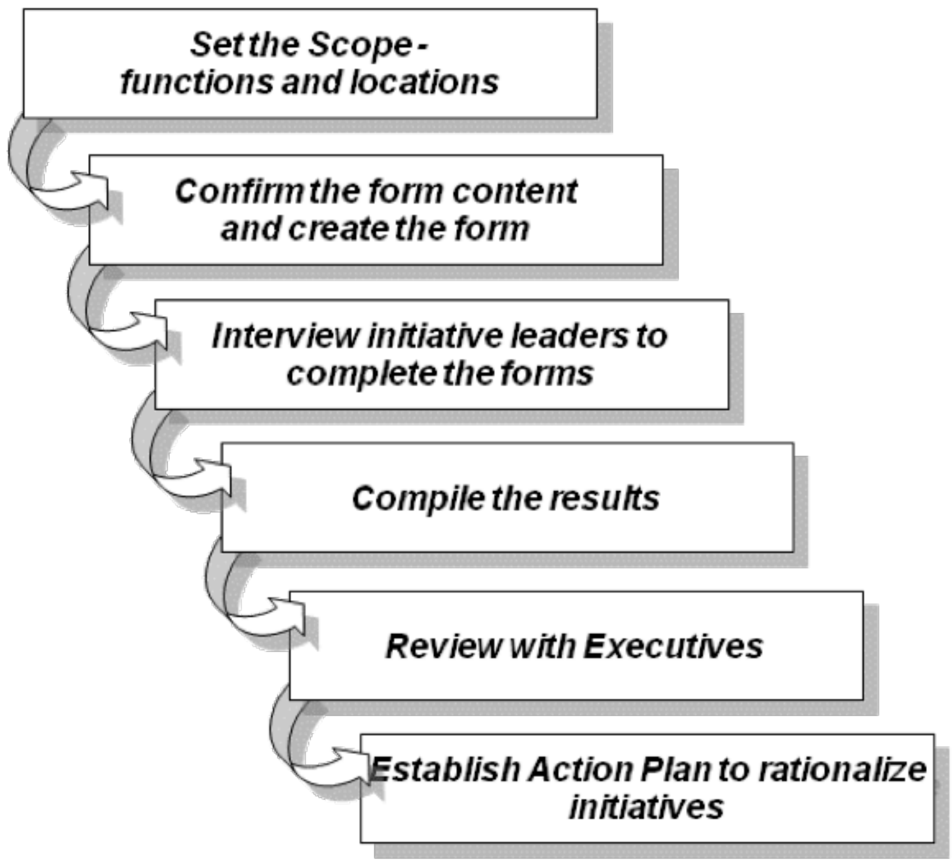
Elevator Pitch

“Large, complex companies often dissipate energy in worthy but uncoordinated projects. There is value in placing them all on a level and visible playing field.”

There is benefit to communicating this review openly and up front with the whole organization, and especially the initiative sponsors and participants, as there may be disappointments as favorite projects are revised or killed, and a clear rationale explaining priorities and resource capacity will make it easier to understand and support.

How to Perform the Review

An initiative review is simple in concept but more interesting in execution. This page illustrates the sequence of the activities of an effective review.



1. Set the scope, determining which functions and locations are to be reviewed. In general, you should attempt to get your arms around every initiative of any scope within your area of control. The initiative review is most effective if it is sanctioned by the executive team and includes the whole organization.

2. Confirm the form content and create interview / data collection / summary forms. Most initiative reviews will include the information suggested in this chapter, but there could be additional demographics (such as business units) or additional data (such as specific types of non-financial metrics) needed.

3. Interview initiative leaders to complete the forms. These forms do not work well as survey instruments because initiative owners may not interpret them correctly and more importantly may not want to cooperate fully. The interview format affords the opportunity to explain the intent and sell the concept.

4. Compile the results. The summary form will capture all required information for a collection of simple initiatives. If interview forms are needed, they can be added to the Summary form.

5. Review with Executives. The purpose of an initiative review is to bring executive focus and control to resource investments, so the full executive team should begin the rationalization process with a formal briefing in workshop format. The Summary form provides grist enough for the inevitable questions and follow on discussions. The analyst will certainly be asked for an opinion and needs to bring recommendations to the executive briefing.

6. Establish an Action Plan to rationalize initiatives and reassign resources, as needed. This will often include executive workshops, creation of an Executive Steering Team, and project charter development assignments.

Initiative Review Summary Form

The form on page 223 is used to collect information about all initiatives in order to compare them and see the total impact of these activities. For relatively small initiatives, the information on this form may be sufficient. For more complex or dispersed initiatives, and those with more impact, the data collection form shown on a later worksheet may be a better guide for interviewing an initiative owner.

Effective initiatives have a number of elements in common, as suggested by the data on this form. The initiatives review should address the following questions, and weaknesses need to be highlighted regardless of politics and inertia:

- Is there a sound business reason for the initiative? How was it created, designed, and launched?
  - Did an executive team agree on it and assign the resources?
  - Is there a credible business case?
  - Is there a clear and complete charter, including clear metrics to indicate success or failure?
- Is there an executive sponsor removing barriers and providing insight and support?
- Are there any resources with accountability and dedicated time to drive the initiative?
- How is the initiative performing? On schedule? Meeting expectations of improvement?
- How and when are accountable executives updated?

	Initiative Title	Champion	Leader	Resources Assigned	FTE Hours per Week	Start Date		Completion		Dollar Benefits		Written Charter?	Weekly Update?
						Scheduled	Actual	Scheduled	Actual	P&L (Annual)	Balance Sheet		
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													

Detailed Interview Form

The individual project interview form (page 225) is for identifying on-going projects, initiatives, improvement efforts, task forces, etc. that an organization is using to take costs out, make things more efficient and/or improve throughput. The reviewer needs to complete one of these for each initiative they hear about. They may have to do a little interviewing, and should pay particular attention to benefits the initiative team thinks they will get and what they have gotten so far. Just as critical is how the team is measuring or valuing it and what metrics they are tracking. The form should be modified as needed for the reviewer's organization, but should contain at least the information of this form and must be the same form for all initiatives so it can be summarized unambiguously.

Once all known initiatives are documented on this form, they are collected on the Summary form (page 223) for analysis. If the reviewer finds that every possible dollar is being pursued by ten different projects and/or there is little progress and/or things are poorly defined, the executive team should rationalize the set of initiatives immediately, cutting back or cancelling poorly structured initiatives and refocusing the head count to better effect.

Initiatives Review Form

Date	
Analyst	

Initiative Title	

Objectives	1	
	2	
	3	

Function	
Location	
Type	

	Scheduled	**Actual**
Start Date		
Completion		

Champion	
Leader	

Resources Assigned	
FTE Hours per Week	

Activities	1	
	2	
	3	
	4	
	5	

Dollar Benefits	**Estimate**	**Actual to Date**
- Annual P&L		
- One Time Balance Sheet		

	Metrics/Measures Tracked	**Where?**	**Validated By**
1			
2			
3			

	Yes	No
Written Charter?		
Weekly Update?		

NOTES:

Make Up Your Mind

Decision Tools

Decision making is a fundamental task of operations analysis and management, and a key function of managers at all levels. Entrepreneurs with excellent instincts may make 'gut feel' decisions successfully, but management professionals in complex operations rightly ask for better rationale before they commit funds. Without getting buried in the analysis, it is possible to develop strong indicators of success to support a decision using such common decision tools such as Decision Trees and Linear Programming. Each has its strengths, limitations, and proper applications, and in the final decision is merely another data point – at the desk where the buck stops, there is no ducking.

> <u>Elevator Pitch</u>
>
> "Management exists to make decisions. There are tools that can help, but eventually the buck stops somewhere."

Dealing with Uncertainty

We are all familiar with the risk of gambling and the uncertainties associated with coin tosses, dice rolls, and card dealing. Consider each of these:

- Each time a coin is tossed, there is a 50% chance that the outcome will be heads (or tails). But if it is tossed twice, the probability that it will be heads (or tails) both times is only 25% (50% times 50%); in three tosses the probability of all heads (or tails) is 12 1/2% (50% cubed), and so on.

- A die has 6 possible outcomes, or 16 2/3% probability for any particular number. The probability of rolling the same number twice in a row is only 1 in 36.

- A deck of cards has 52 possible outcomes - the probability of pulling any particular card is 1 in 52. Most of the interesting games with cards involve complex combinations, with less probable combinations (such as a royal flush) being increasingly valuable. Excellent card players simply understand the odds and can even estimate changing odds as a game progresses.

Similarly, in business excellent decision makers understand the probabilities of success and the costs of failure, and attempt to ‘stack the deck’ in favor of success. A Decision Tree represents a logical way to understand the probabilities.

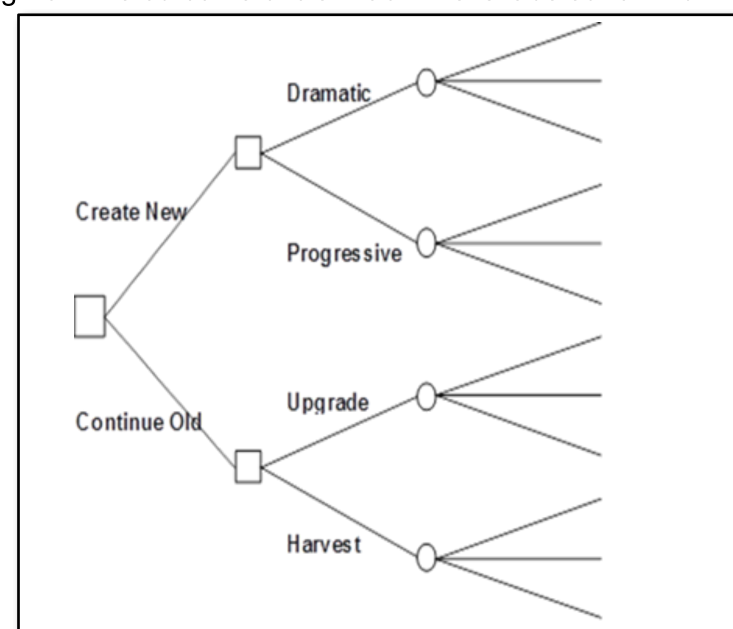
Decision Trees

A Decision Tree is a graphical representation quantifying the value of a series of decisions that an organization faces. It is often a rough estimate because outcomes are uncertain, and the final outcome of a progression of decisions is increasingly less certain. Nonetheless, the approach is instructive in that it forces logical thinking and can lead to constructive risk management techniques.

Step 1: Tree Structure

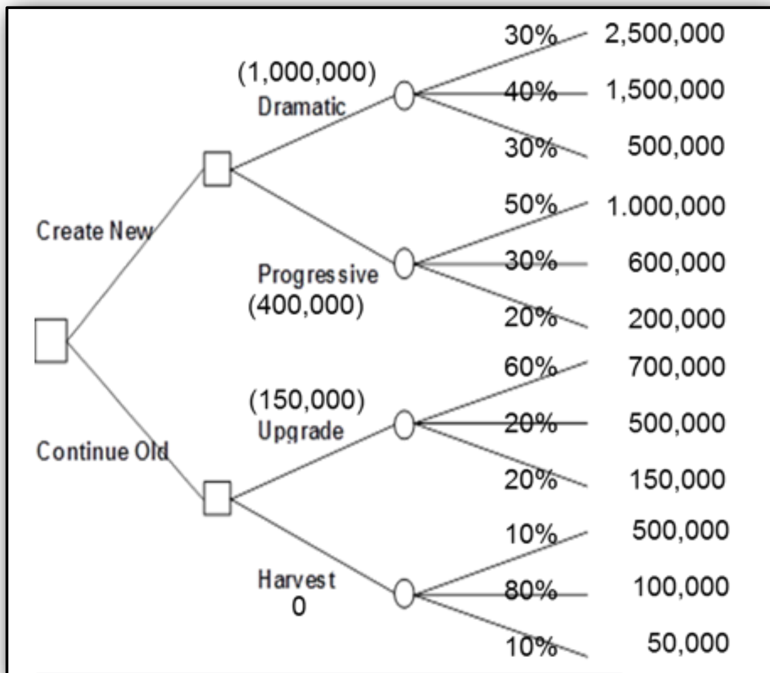
To construct a Decision Tree, start by considering what the decision is. Generally this is depicted as a box with lines emanating from it, each representing the next decision and leading to an outcome, often depicted as a circle, as shown.

For example, imagine that you have $1 million dollars to invest, and you need to decide whether to upgrade your main product or develop a new product. In this example, you might draw a diagram similar to the one shown here, choosing to develop a dramatic or a progressive new product, or to upgrade or harvest your current product. Each choice has different possible outcomes, represented by a line emanating from the outcome circle. Each line is labeled for intuitive reference.



Step 2: Estimating Value

To begin estimating value, we consider the probable market reaction - how much profit might we make in each case? Here we estimate that a dramatic new product has a 30% probability of earning \$2.5 million, 40% of earning \$1.5 million, and 30% of earning only \$500,000. Similarly, we have estimated the probabilities of profits for each of the other decisions we might make. In the case of harvesting our existing products, we see a possibility that obsolescence may significantly reduce our profit, with a 10% probability that we will only earn another \$50,000 if we do nothing.



Of course, we rely on experts to estimate outcomes and probabilities. In this example, those experts probably reside in the market research department.

Step 3: Estimating Cost

Next, we estimate the cost associated with each decision (shown in the diagram on the previous page). Again we would rely on experts, in this case possibly in the engineering department. Note that we would need the whole \$1 million dollars to create a dramatic new product, employing our whole war chest and limiting our other options.

Step 4: Estimating a Value of Each Outcome

By subtracting the costs associated with each option, we calculate a value for each outcome. For example, we subtract the $1,000,000 investment from each branch of the 'Dramatic New Product' decision to get values of $1,500,000, $500,000, and -$500,000 for the three outcomes.

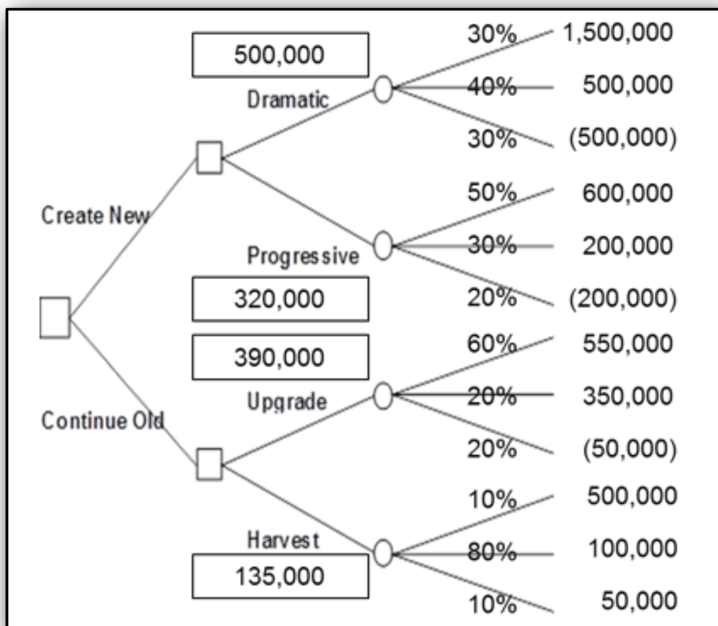
Step 5: Calculating the Expected Value

Following the methodology of Blaise Pascal, the great eighteenth century French mathematician, we can calculate an expected value for each decision as the sum of the outcomes times their respective probabilities. For the dramatic new product, the expected value is:

1,500,000 x 30%
+ 500,000 x 40%
+ (-500,000) x 30%, or

450,000
200,000
(150,000)

500,000



Each of the other decisions is similarly calculated and the values appear in the boxes above each option's outcome node. The 'New' versus 'Upgrade' decision is valued based on the highest value of each option's sub-decisions.

Interpreting a Decision Tree

From a purely mathematical position, the decision to develop a new product is most probably the best to take, since we estimate it to be worth 500,000 (the highest value on that node) versus 390,000 from continuing our current product line. And the dramatic development seems the better of the two new product options. But before arriving at that conclusion, consider:

- The dramatic option uses the whole war chest. It could be a ‘bet your company’ decision. Can that risk be mitigated?
- The war chest would cover both an upgrade and a new but only progressive product. Would they cannibalize each other? Could they be done sequentially?
- We might be able to reduce our risk by ensuring our market research is accurate (multiple sources, industry experts, etc.) or by focusing on less expensive development and/or production methods.

You will never have perfect information. How much of what kind is enough? How can you get it? The Decision Tree is instructive but generally not sufficient for sound management decisions.

Great leaders base their decisions on a depth of knowledge accompanied by creative, strategic insight. General George Patton and Napoleon could visualize their terrain and their adversaries' reactions while understanding exactly what their key technologies (tanks and artillery, respectively) could do. Successful business leaders must also understand the strengths and limitations of their products and organizations in attracting customers profitably before launching bold new initiatives. All great leaders take risks, mitigated by their deep knowledge, superior insights, and creativity, but risks nonetheless. Luck favors the prepared.

Linear Programming

Linear Programming (LP) attempts to find the best solution (for example, highest profit or lowest cost) in an environment of constraints (such as limited market demand or scarce labor). It can involve extremely complex, multi-dimensional models. Here we illustrate the concept with a simple, commonly used 2-dimensional LP graph format.

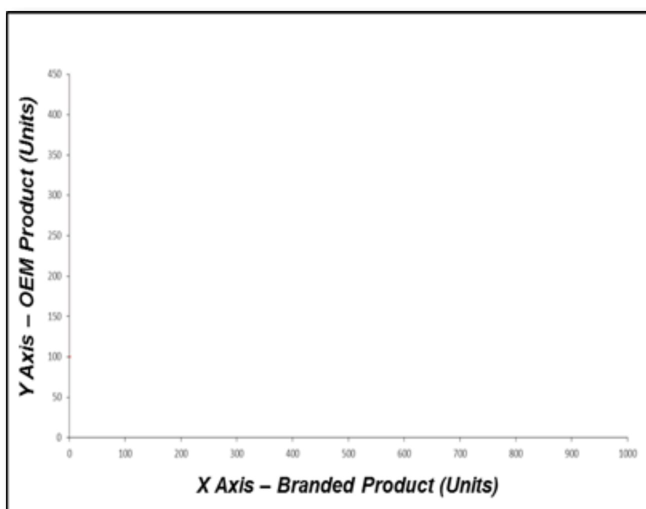
Step 1: Understand the Problem

To be useful in business, it is helpful to start any LP exercise with a word problem such as:

> "XYZ Company sells a product under its own brand name, and sells quality seconds to OEMs. The branded model provides more revenue and profit per unit but its market demand is limited, and the factory capacity for total combined units is also limited. For reasons of profitability, the product mix needs to favor branded product. The company could sell as many of the OEM model as they could make, and has in fact a minimum requirement due to a long-standing contract. Branded units cost $2.75 to make and sell for $4.00; OEM products cost $2.65 to make and sell for $3.25. How many branded and OEM units should they plan to produce? How much profit contribution will result?"

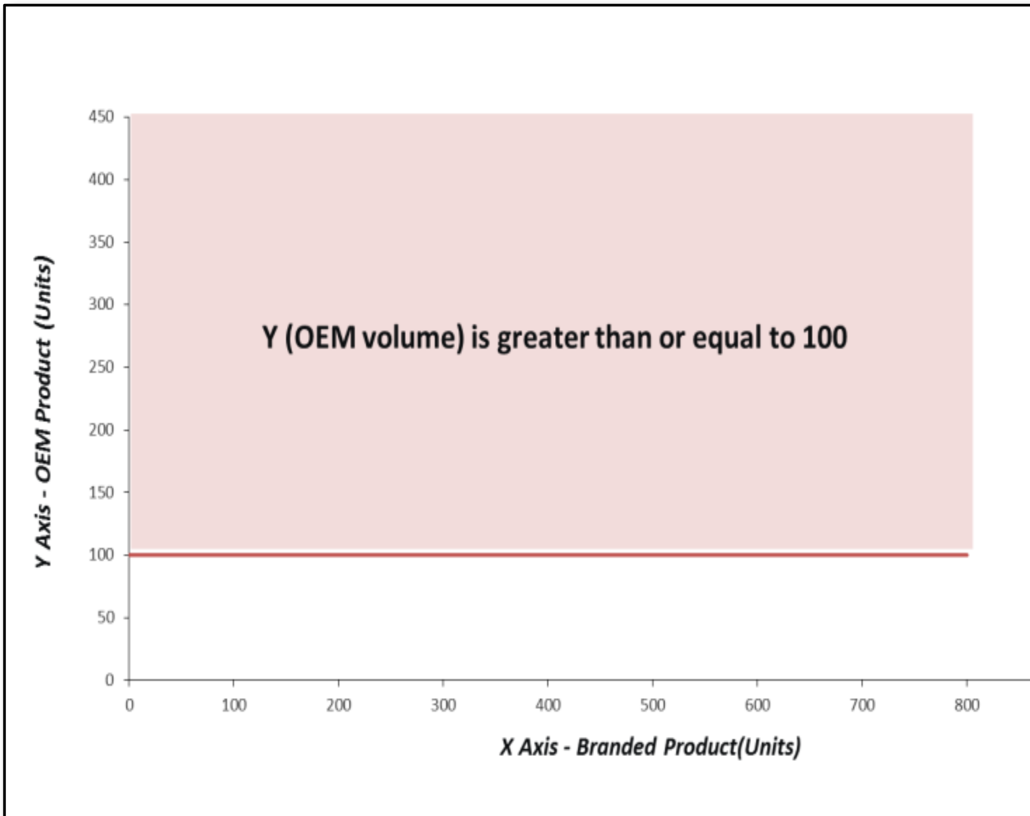
Step 2: Define the Chart Axes

Linear Programming graphs can readily illustrate the choices between these alternative products. Here we show branded product on the x axis and OEM product on the y axis.



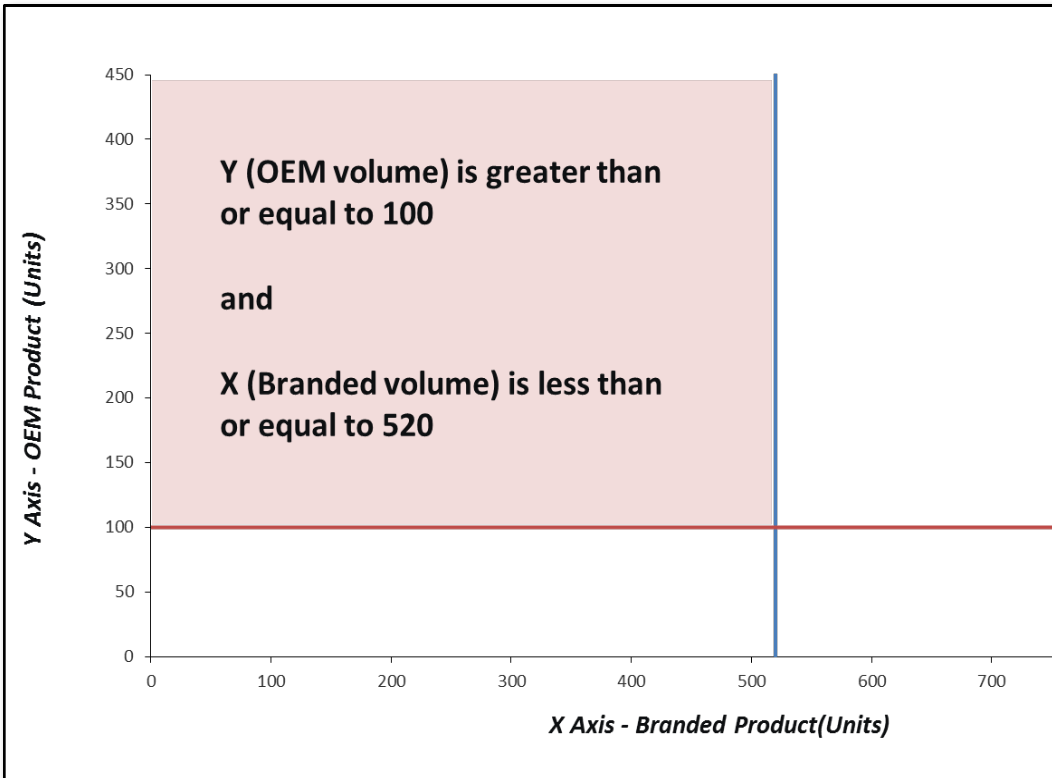
Step 3: Enter the First Constraint

The company has determined that the minimum demand for OEM product is 100 units per day, so our first constraint is depicted as a horizontal line intersecting the y axis at 100 units.



Step 4: Enter the Second Constraint

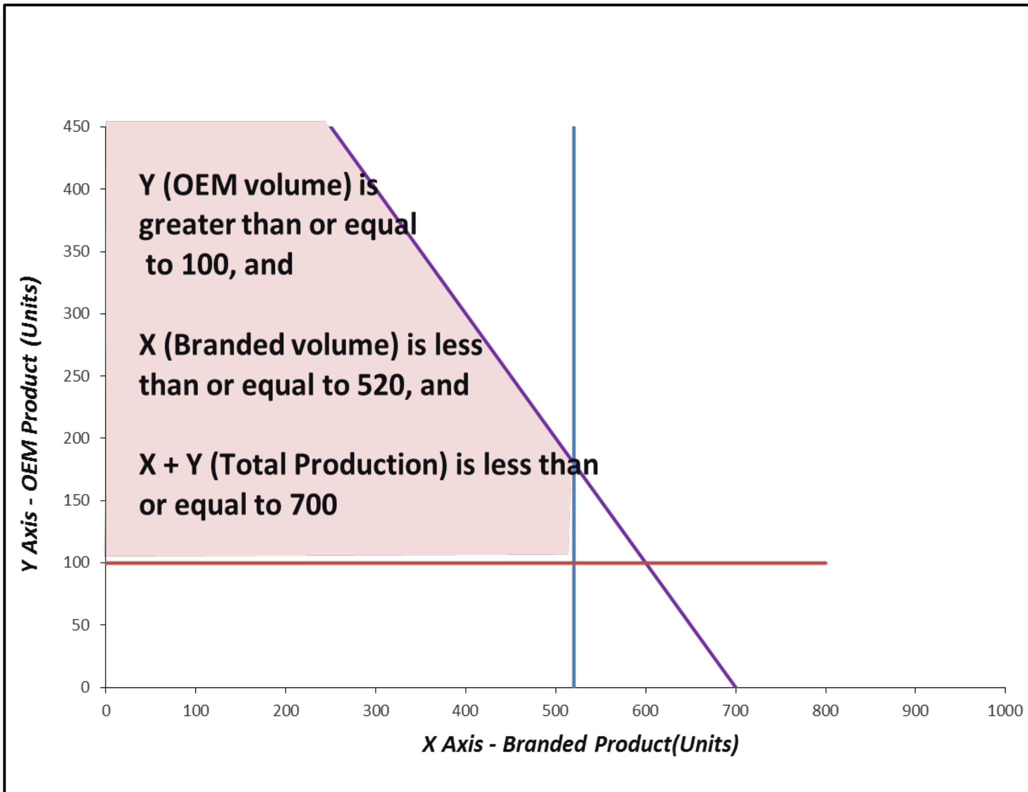
Assume we can sell no more than 520 units per day. This constraint results in a vertical line at X (the branded product) = 520. Anything to the left of that line is possible, except for the numbers below Y = 100, due to the OEM restriction already in place.



Step 5: Enter the Third Constraint

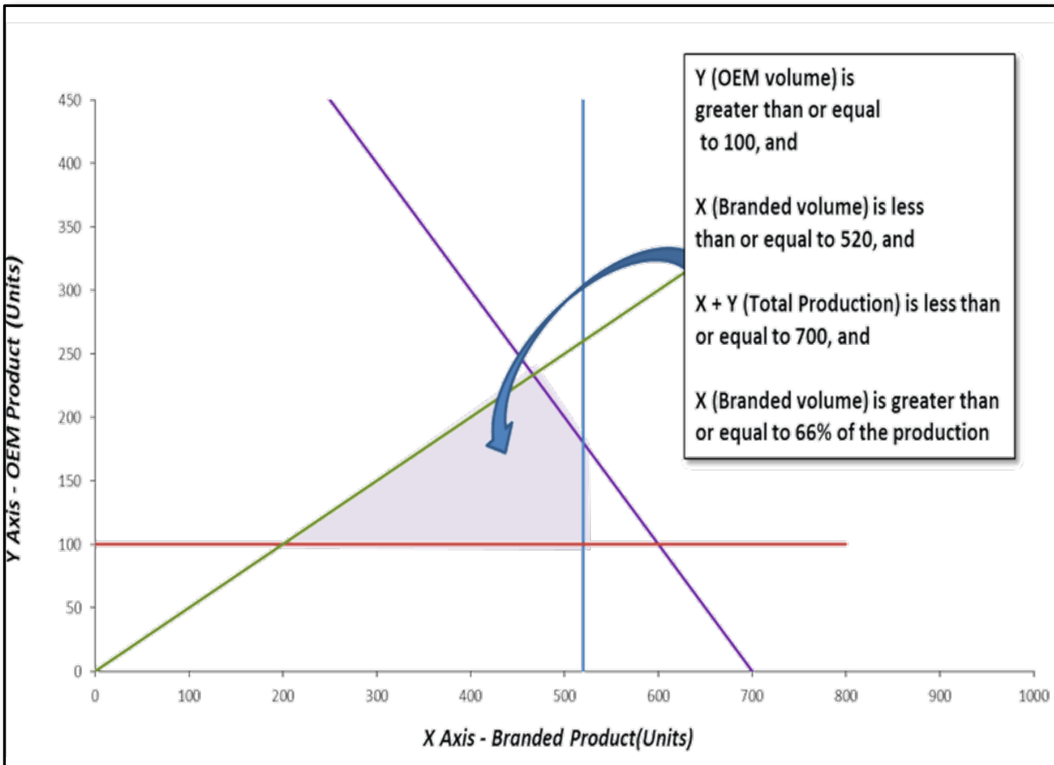
The company has determined that the maximum daily unit production of both types is 700. We depict that as a line intersecting the y axis at 700 sloping downward to intersect the x axis at 700.

So far, the production could be any mix of branded and OEM units under that line (including zero, if we were not interested in making any money).



Step 6: Enter the Fourth Constraint

Finally, assume there is a mix constraint - at least 2/3 of the product must be branded, due to market presence requirements. This results in a line that starts at zero and extends upward to the right passing through all points where X = 2Y, as shown. Any value to the right of this line is possible unless already constrained.



Step 7: Calculate the Value

In this simple case, where maximum profit is the goal, we know by inspection that we will first maximize our branded sales (with higher unit profit) to ensure optimum profit, then fill the plant to capacity with OEM product. The value is computed by multiplying the unit volume by the profit for OEM and for branded sales:

520 x ($4.00 - $2.75)
+ 180 x ($3.25 - $2.65)
= $650 + $108 = $ 758.

In this simple case, the calculation is intuitive and straightforward. In more complex cases, it may be necessary to calculate the values at each intersection point, and computer models may be needed.

In our final chart the OEM minimum is a horizontal line, the mix of OEM and branded product is diagonal up toward the right, the maximum branded production is a vertical line, and the capacity constraint is a diagonal line that descends toward the right. All of the possible production solutions are bounded by these lines, and the area of possible solutions is shaded.

Interpreting an LP Chart

Constraints themselves may be inexact estimates, and management may have choices that will impact them. Note that changing any particular constraint on this chart might change the optimum solution (for example, by increasing the possible total production you could produce more OEM units), assuming all other constraints remain in effect.

To improve the situation (broaden the options by removing constraints), start by considering the maximum branded sales. Management could seek ways to drive this demand, though there is risk of inviting competition or disappointing customers if demand exceeds capacity significantly.

Increasing the minimum OEM demand (moving the green line upward) has no effect until plant capacity is filled. Beyond that point, the company must sell lower profit OEM product in lieu of branded product.

Increasing OEM capacity in the mix only makes sense if production capacity is increased, otherwise this additional capability will go unused.

Increasing capacity could support maximum sales of branded and OEM product, but the mix constraint would need to be adjusted after the branded demand constraint was reached.

Complex Problems

Linear programming can involve many more constraints and multiple dimensions, with much more complex mathematics than this simple example. Such complex math is beyond the scope of this material, but easy to find on the Internet.

NOTES:

Just Enough Math

About Math Tools for Business

While general business professionals don't need degrees in higher mathematics to be successful, the basics (adding, subtracting, multiplying and dividing without relying on fingers and toes) are required skills, and some understanding of more complex math can enhance critical thinking about analyses presented for decision-making

> Elevator Pitch
>
> "A real manager doesn't need a picture of a hamburger on the cash register key to make change."

Many of these more complex tools involve statistical methods that predict future events for planning purposes. Queuing theory, regression, and quality sampling tools are good examples. Statistical Process Controls, described in the chapter on Six Sigma, also employ statistical methods, to capture and address problems as they develop in production. Linear Programming, as described in Chapter 12, uses sometimes very complex math to optimize performance in the face of a web of constraints.

This brief introduction to mathematical models and techniques is intended for a general business audience, and no mathematical formulae are presented. The intention is to demonstrate a few of the most popular and useful tools for familiarity, assuming serious students of math will refer to the excellent free and for sale training and software resources available on the Internet and from other sources.

Acceptable Quality Level (AQL)

Quality Control measures attempt to ensure that produced items are of acceptable quality before they are used, by applying complex statistical techniques in a discipline known as ‘Acceptance Sampling.’ Acceptance Sampling is a compromise between not doing any inspection at all and inspecting 100% of the units in each batch. The objective is to make product disposition decisions based on informed quality estimates.

The key concepts originated in World War II, when the U.S. military needed to ensure ordnance would work in the field. Of course they could not test it all, so they turned to statistical methods to determine what representative test sample would provide confidence that a batch was good.

Representative samples are selected from a population and tested to determine whether the lot is at an Acceptable Quality Level (AQL) using an ‘Acceptance Plan’ or ‘Sampling Plan,’ based either on attributes of individual discrete tested products or on statistical measures of batch variables.

The chart on page 243 represents a military standard for designing an acceptance plan. From the chart one can determine that in a batch of 100,000 units, if 1% (1,000 units) out-of-spec is acceptable, then 500 units should be tested and of these no more than 10 can fail. If they do, the batch should be rejected because it probably contains too many unacceptable units. If fewer than 11 defects are found, the batch may be accepted as the odds are that no more than 1% of the population is defective.

In applying this standard the Producer and Consumer need to agree:

- What the AQL is for a given product characteristic
- That the Producer will submit lots at the specified quality level
- That a tighter standard will be applied if lots do not meet the Consumer's requirements.

The particular standard shown (105D) was issued in 1963 and adopted in 1971 by the American National Standards Institute as ANSI Standard Z1.4 and in 1974 (with minor changes) by the International Organization for Standardization as ISO Standard 2859. Such standards are widely applied in government and industry worldwide.

		Acceptable Quality Levels (AQL) for Normal Inspection (% defective)													
		0.01	0.015	0.025	0.04	0.065	0.1	0.15	0.25	0.4	0.65	1	1.5	2.5	4
Lot Size	Sample Size	Maximum Number of Rejects to Accept the Lot													
2 - 8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9 - 15	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 - 25	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 - 50	8	0	0	0	0	0	0	0	0	0	0	0	0	1	1
51 - 90	13	0	0	0	0	0	0	0	0	0	0	0	0	1	1
91 - 150	20	0	0	0	0	0	0	0	0	0	0	0	0	1	2
151 - 280	32	0	0	0	0	0	0	0	0	0	0	0	1	2	3
281 - 500	50	0	0	0	0	0	0	0	0	0	0	1	2	3	4
501 - 1,200	80	0	0	0	0	0	0	0	0	0	1	2	3	5	7
1,201 - 3,200	125	0	0	0	0	0	0	0	0	1	2	3	5	7	10
3,201 - 10,000	200	0	0	0	0	0	0	1	1	2	3	5	7	10	14
10,001 - 35,000	315	0	0	0	0	0	0	1	2	3	5	7	10	14	21
35,001 - 150,000	500	0	0	0	1	1	1	2	3	5	7	10	14	21	-
150,001 - 500,000	800	0	0	0	1	1	2	3	5	7	10	14	21	21	-

AQL is part of the QC equation, describing what should always be accepted. It will also be helpful to know what should always be rejected, using Lot Tolerance Percent Defective (LTPD) measures, and the probabilities that the sampling plan will ensure good product, using an associated Operating Characteristic (OC) curve.

Operating Characteristic Curve

Sampling Plans are imperfect, and provide only a good guess about the quality of a batch. Based on the quality level needed, the AQL chart suggests how many units need to be tested and what maximum failure level would indicate a batch was probably of acceptable quality. A batch should never be accepted if it exceeds the failure level specified in the plan. But how good is it if it passes?

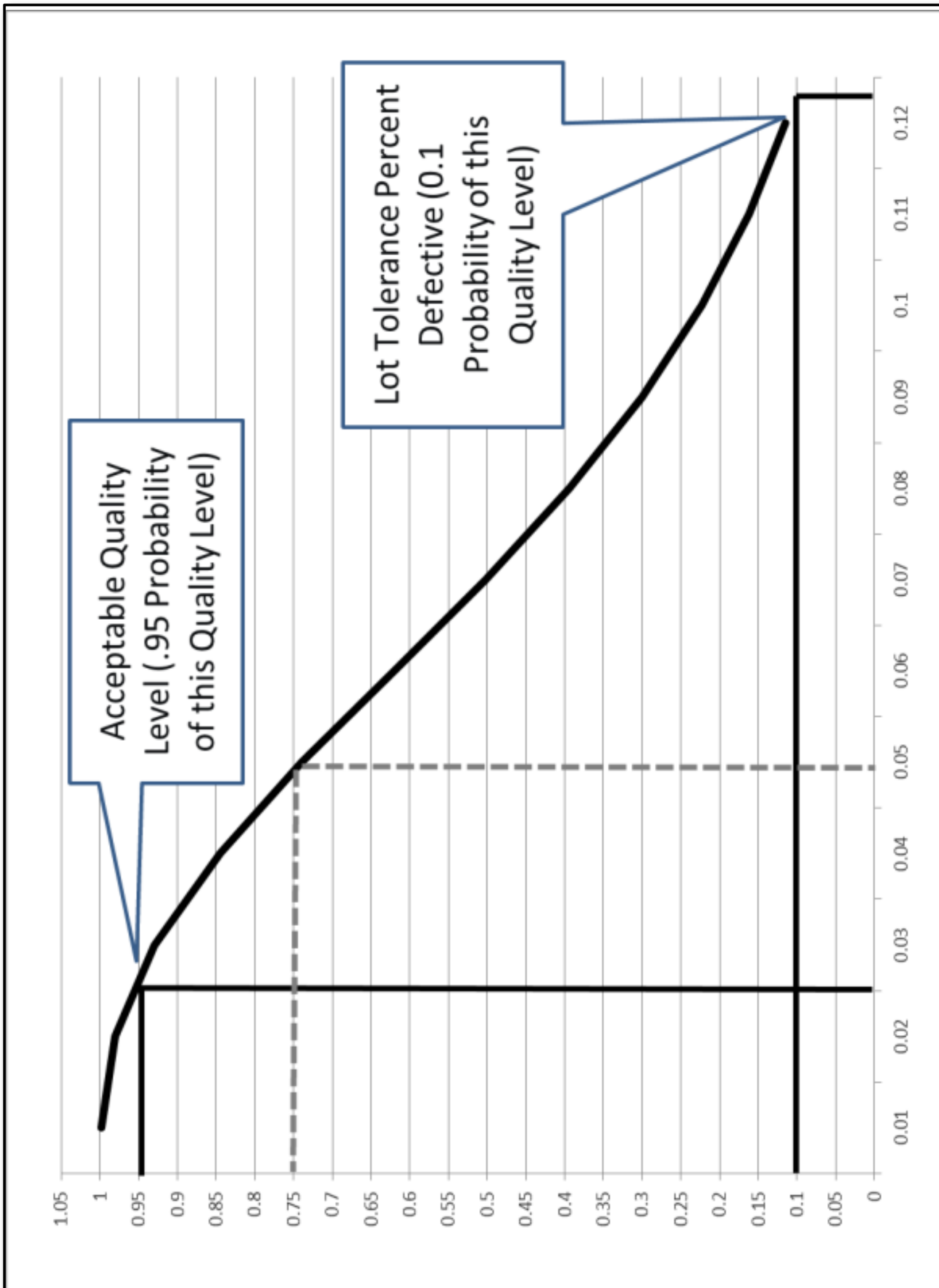
The risks of a Sampling Plan are described by an Operating Characteristic (OC) curve such as the typical one depicted below, which plots percent defectives versus the corresponding probabilities that each percent will be accepted. This curve is derived using a statistical formula based on defectives encountered, sample size, and acceptable quality.

In the curve example shown, AQL is set at the 2.5% quality level. Two points on this curve are of particular importance: the AQL and LTPD. At the AQL point, there is by definition a 0.95% probability that the 2.5% AQL will be met.

The Lot Tolerance Percent Defective (LTPD) is generally defined as that level of quality (percent defective) that the Sampling Plan will reject at least 90% of the time. In the example shown, the LTPD is in the 12.75% range. This means that if a lot passes the Sampling Plan, we have 90% confidence that the quality level (defective rate, etc.) is better than the LTPD.

Along this curve we can estimate the probabilities of other defect rates. For example, if a lot is 5% defective the probability that the Plan will accept it is 0.75 (illustrated by the dotted line).

Note that Acceptance Plans use metrics similar to Statistical Process Controls (used to correct processes as they occur) but are focused on disposition of produced materials and use different mathematical tools and techniques. Both are important and complementary.


Acceptable Quality Level (.95 Probability of this Quality Level)
Lot Tolerance Percent Defective (0.1 Probability of this Quality Level)
1.05 1 0.95 0.9 0.85 0.8 0.75 0.7 0.65 0.6 0.55 0.5 0.45 0.4 0.35 0.3 0.25 0.2 0.15 0.1 0.05 0
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.1 0.11 0.12

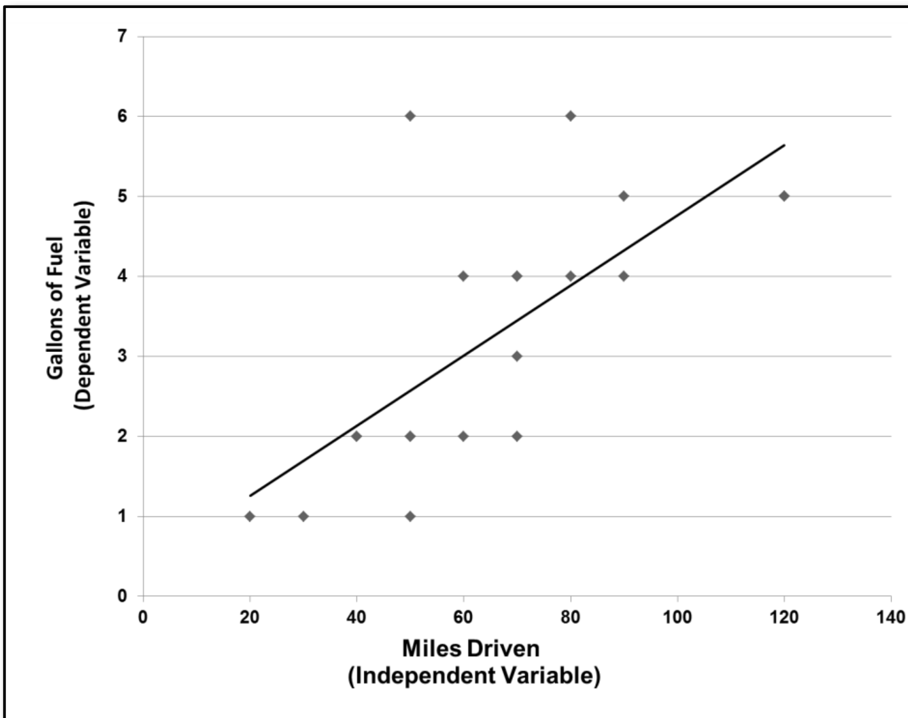
Queuing Analysis

Queuing theory is the mathematical study of waiting lines (or queues) in order to calculate and manage performance such as waiting time and line length, and predict and plan for future performance. The theory is used to enhance performance in a variety industries (for examples, fast food, transportation, health care, on-line or phone customer service, and banking), by staffing or investing in supporting systems such as intelligent transportation systems, call centers, PABXs, networks, telecommunications, servers, and the like.

Mathematical analyses focus primarily on estimating the demand for services, using statistical tools to estimate, for example, frequency of random demand and peak demand, and may incorporate customer behavioral traits and service cost factors to manage queues.

Regression Analysis

Regression analysis is a modeling technique used to understand the relationships between one or more independent variables and the dependent variable that they affect. For example, plotting miles driven against the fuel usage on a series of trips would likely produce a straight line relationship (because miles per gallon would be a nearly constant factor).



In the typical chart shown the data points are scattered, but using the 'least squares' method a trend line has been created to suggest the most likely relationship between miles and gallons. This chart could then be used to predict how much fuel would be needed for a trip of any length. Such planning may be casual in normal life, but predictions of this sort are critical in air flight planning, military operations and on production lines where the cost of running out is unacceptably high.

The mathematics and rules for data management and calculation become increasingly complex as more variables are introduced, and it is always important to remember that mathematics involving statistics always contains potential errors and unknowns - just like life!

Analysis of Variance (ANOVA) 11

In statistics, analysis of variance (ANOVA) is a collection of statistical models and their associated procedures designed to determine causes of variance.

For example, one might hypothesize that grass grows better with a particular fertilizer and test this by using different fertilizers, then measuring the effects such as length of stalks or richness of color. If the mean length/color of the particular fertilizer's grass varies significantly (better) from those characteristics of the alternative types, it is probable that the hypothesis is correct.

The null hypothesis is that there is no difference, and is disproven when significant differences are identified.

ANOVA and related techniques rely on complex statistical analysis beyond the scope of this text but readily available on the Internet. Wikipedia is a good starting

One-Way
Analysis of Variance

- One independent variable is tested
- Null indicates no difference
- Otherwise there is a difference

Two-Way
Analysis of Variance

- Two independent variables are tested
- Null hypothesis #1: there is no interaction between the two factors.
- Null hypothesis #2: the population means of the first factor are equal
- Null hypothesis #3: the population means of the ○ second factor are equal.

NOTES:

Get Some Really Big Brains

Ubiquitous Systems

Since IBM introduced the general purpose Model 360 computer in 1965, all organizations have moved to increasingly powerful, cheaper, and more sophisticated solutions. As a highly visible example, Wal-Mart today operates one of the most sophisticated supply chains on the planet, with powerful links to an integrated set of organizations worldwide, totally linked by systems. Meantime, Mom and Pop shops sell on the Internet and keep their books on their personal computers.

Elevator Pitch

"Virtually everyone – in any organization – touches systems. Lack of the right information in the right place at the right time can bring most organizations directly to their knees."

This chapter briefly introduces several systems that business analysts must understand:

- Manufacturing Resource Planning systems
- Supply Chain software and CPFR
- Enterprise Resource Planning systems
- Small business solutions

Material / Manufacturing Resource Planning (MRP) [12]

Material requirements planning (MRP) is concerned primarily with manufacturing materials while further evolved Manufacturing resource planning (MRP II) addresses operational planning (units) and financial planning (dollars), and has a 'what-if' simulation capability. These are implemented with modular software linked to a central database of business data and information for the purpose of using human and material resources more productively.

Prior to and with early computers, paper-based information systems and non-integrated systems led to numerous information errors (missing, outdated, redundant and un-reconciled data, data incorrectly keyed in, manual miscalculations) resulting in poor decisions. Also, different functional areas used incompatible databases, significantly degrading decision-making information.

In the 1980s, to facilitate 'error free' material movement, manufacturers developed early MRP systems for calculating the resource requirements of a production run based on demand forecasts. The size and complexity of the databases dictated the use of computers, originally using custom software programs that ran on mainframes.

In the 1990s, MRPII systems linked more supply chain, financial, and human resources information and production management capability into MRP databases and algorithms. Drawing on a master production schedule, MRPII produces detailed labor and machine production schedules coordinated with machine and labor capacity, linking materials movement to production runs. Data about the cost of production, including machine time, labor time and materials used, as well as final production numbers, may be provided to accounting and finance in real time.

MRP II systems can provide:

- Better control of inventories
- Improved scheduling
- More efficient and effective collaboration with suppliers
- Improved quality control for design / engineering
- Reduced working capital through less inventory and quicker deliveries

Customer Relationship Management (CRM)

Customer Relationship Management is a very old concept with a very new set of tools. Essentially, these systems are intended to help salespeople by providing instant access to customer records, which might include such information as:

- Name, address, phone, e-mail
- Demographic data
- Shopping history and preferences
- Billing department information
- Customer service records
- Records of all contacts

CRM data is also commonly used by accountants, product planners, and marketers. CRM systems are evolving from weak and disconnected sets of files into more integrated and robust solutions.

Supply Chain Software and Collaborative Planning, Forecasting and Replenishment (CPFR)

Elevator Pitch

"CPFR removes waste from every part of the supply chain by managing supply and demand for all partners storing and delivering goods."

Step-by-Step [13]

Wal-Mart approaches its CPFR effort following this approach:

1. Develop Front End Agreement
2. Create the Joint Business Plan
3. Create the Sales Forecast
4. Identify Exceptions for Sales Forecast
5. Resolve/Collaborate on Exception Items
6. Create Order Forecast
7. Identify Exceptions for Order Forecast
8. Resolve/Collaborate on Exception Items
9. Order Generation

Supply chains move every raw material, part, and product on earth to their point of use. This is a monstrously complex set of tasks involving millions of people, billions of daily transactions, and billions of dollars of equipment, and raises continuous, enormous challenges.

Enter the computer, and supply chain management software (SCMS), a whole range of software tools that plan and execute supply chain transactions. SCMS is often modular but modules often work seamlessly together to:

1. Process customer requirements (for successive customers along the value adding chain)
2. Process purchase orders
3. Manage inventories in storage or transit
4. Help manage suppliers
5. Apply forecasting tools to the supply / demand equations

SCMS integration solutions allow organizations to trade with their partners electronically, moving goods and money with highly leveraged human oversight.

The current state of the art is known as ‘Collaborative Planning, Forecasting and Replenishment’ (CPFR), a concept that enhances supply chain integration by continuously updating inventory and projected demand, making the end-to-end supply chain process more efficient. The benefits of the improved efficiency in merchandising, inventory investment, logistics, and transportation are shared by all trading partners. CPFR began as a 1995 ‘Open Source’ initiative co-led by Wal-Mart's executives and the Cambridge, Massachusetts software and strategy firm, Benchmarking Partners, turning Wal-Mart warehousing and delivery systems into competitive weapons.

Enterprise Resource Planning (ERP) [14]

Enterprise resource planning (ERP) is the planning of how business resources (materials, employees, customers etc.) are acquired and employed. An ERP system is a business support system that maintains in a single database the data needed for a variety of business functions such as Manufacturing, Supply Chain Management, Financials, Projects, Human Resources and Customer Relationship Management.

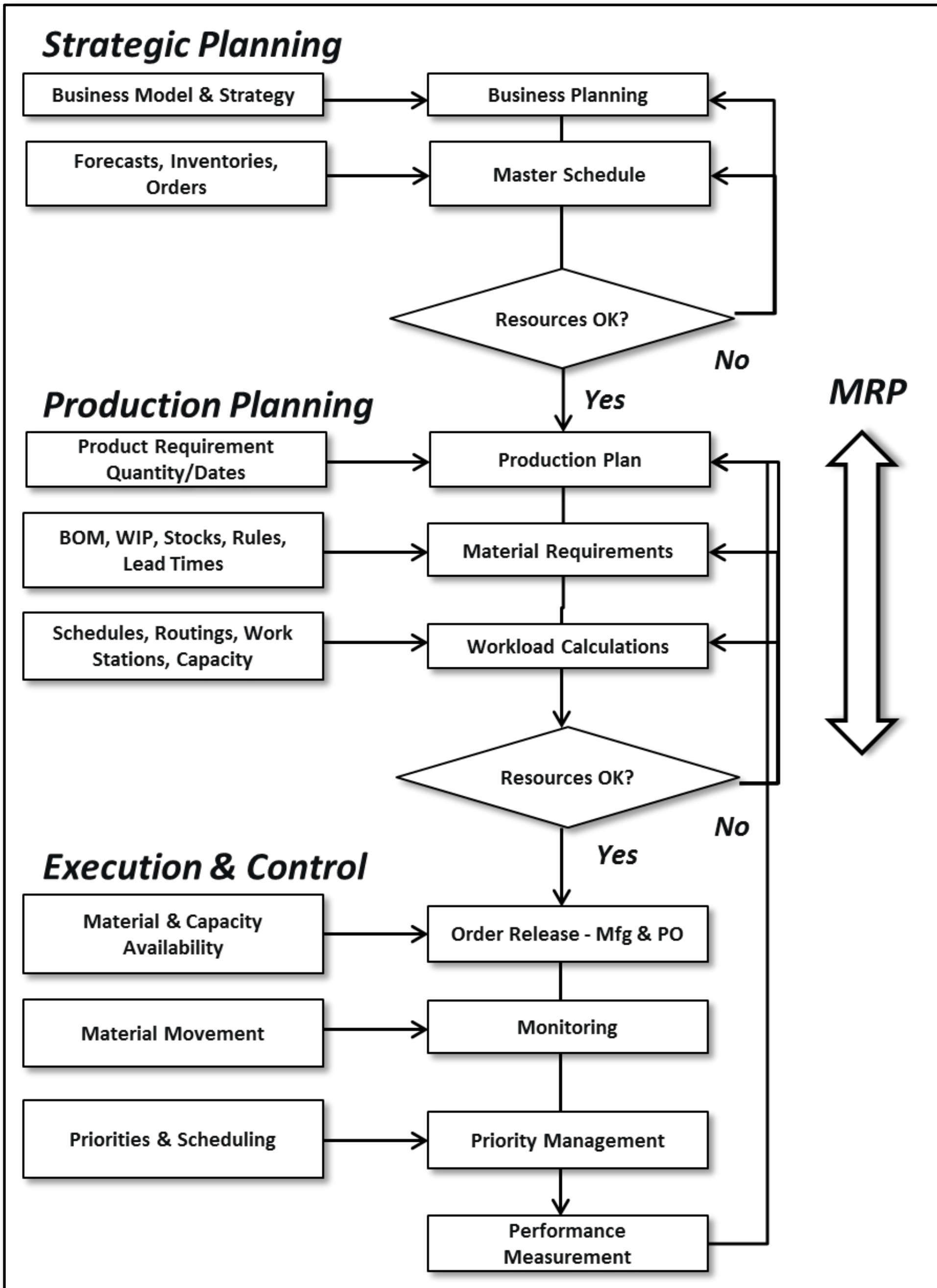
An ERP system is based on a common database used by modular software. The common database can allow every department of a business to store and retrieve information in real-time reliably, and easily. ‘Modular’ implies that a business can select the modules they need, mix and match modules from different vendors, and add new modules of their own to improve business performance.

Ideally, the data for the various business functions are integrated, but in practice ERP systems often comprise a set of discrete applications, each maintaining a discrete data store within one physical database.

The initials ERP originated as an extension of MRP (material requirements planning, and then manufacturing resource planning) and CIM (computer-integrated manufacturing) and were introduced by research and analysis firm Gartner.

ERP systems now attempt to cover all basic functions of an enterprise, regardless of the organization's business or charter. Non-manufacturing businesses, non-profit organizations and governments now all use ERP systems.

To be considered an ERP system, a software package must provide the function of at least two systems. For example, a software package that provides both payroll and accounting functions could technically be considered an ERP software package. The example illustrated on the next page contains most of the core functions of an ERP. Other functions critical to a specific company, such as product configurators and customer management tools, are often bolted on.


Strategic Planning
Business Model & Strategy
Business Planning
Forecasts, Inventories, Orders
Master Schedule
Resources OK?
No
Yes
Production Planning
MRP
Product Requirement Quantity/Dates
Production Plan
BOM, WIP, Stocks, Rules, Lead Times
Material Requirements
Schedules, Routings, Work Stations, Capacity
Workload Calculations
Resources OK?
No
Yes
Execution & Control
Material & Capacity Availability
Order Release - Mfg & PO
Material Movement
Monitoring
Priorities & Scheduling
Priority Management
Performance Measurement

Small Business Solutions

Working in a small business today almost always requires significant computer skills. A minimum requirement is facility with Microsoft's Office Suite, and additional skills with CADCAM (computer Aided Design / Manufacturing), CRM (Customer Relationship Management), and small business financial solutions such as Solomon or QuickBooks are essential to business analysis in many environments

To appreciate the challenge of information management in a small business, consider that it must perform affordably many of the functions to which large businesses apply their ERP systems and supply chain software.

Social Media

Every business is affected by social networking, whether intentional or not. Facebook, LinkedIn, Plaxo, and numerous other Internet sites allow conversations to develop on any topic, including discussions about product ratings and service quality, with significant potential impact on marketing and organizational reputation.

Given the unstoppable nature of social networking, It is useful to incorporate its power into marketing plans, attempting to control corporate and product images. The most obvious starting point is to identify the sites that potential buyers / supporters visit and rely on, and mount appropriate content. The most effective campaigns demonstrate expertise and generate an audience that may grow by word of mouth.

NOTE: Individuals, too, are affected by social media and do well to think through their personal 'brand.' Careless words and embarrassing photographs can 'go viral' (take on a life of their own) surprisingly quickly.

Get Some Really Big Brains

NOTES:

Get the Team on Board

About Change Management

Figuring out what to do may be the easy part of making and implementing good decisions. People don't like to change what they do or how they do it until they are convinced it is more effective and efficient, and won't negatively impact the quality of their work life. Most people want to do a good job, but are hampered by weak business models, management systems, and processes. In this chapter we will describe some concepts and techniques for building enthusiasm for change - the right change.

> Elevator Pitch
>
> "This is the human side of improving a business and it is every bit as difficult as reading minds. Unless you are clairvoyant, get help!"

'Low-Hanging Fruit,' 'Quick Wins,' and 'Silver Bullets'

If a process has evolved rapidly from a small operation into something more, It is possible there will be opportunities to harvest low-hanging fruit or gain quick wins (rapid improvements with high visibility and little effort). In these cases, any change effort should start there, and successes should be publicized to build momentum for change.

> Elevator Pitch
>
> "Quick wins are possible if you are standing in your own way, but there is no such thing as a free lunch."

But some executives and managers have a tendency to look for 'silver bullets,' quick and inexpensive solutions that magically improve things dramatically. This wishful thinking can cause them to avoid the hard (and sometimes expensive) work that gains real results.

Expect to work hard to make improvements and you won't be disappointed. You may, in fact, be occasionally delighted to achieve something relatively easily. But when that happens don't congratulate yourself too enthusiastically. It just means you've been doing it really inefficiently.

Team Building Considerations

> Elevator Pitch
>
> "Great teams don't just happen. They are made up of, and led by, the best and brightest."

In business, the most effective work is often done by groups that see themselves as a close-knit team, and teamwork is a critical success factor in problem solving and process improvement activities, where cross-functional perspectives are needed to find the roots of business problems. There are many tools readily available for building teams rapidly.

Here are a few ideas:

- At the initial session, have the team pair off and introduce themselves to one other person in such terms as position, expectations for the meeting, hobbies, and 'one interesting fact' about themselves. Then have each partner of the pair introduce their partner to the larger group.
- Have the team name themselves or their project, and adopt an icon or mascot for their team.
- Use games addressing a serious business topic, that build skills while building the team. For example, supply chain games that provide roles for moving material (on paper or with small icons) can clearly illustrate the power of clear communications in an engaging educational exercise.
- When teaching process improvement techniques, use problems that everyone recognizes. For example, have the team develop a sample flow chart to diagram 'Getting up in the morning,' or 'Taking a trip to the beach.'
- Have working lunches with topics related to the business at hand.
- Have a recognition event at the end of the project to celebrate success and recognize contributions. Invite sponsoring executives and make sure the event is both professional and enjoyable.

And obviously, avoid potentially embarrassing, inane, unprofessional activities of any kind.

You probably noticed that Lean and Six Sigma tools are generally based on common sense, and not particularly intellectually challenging. Nonetheless, they can be misapplied, or applied without discipline, and do more harm than good. Ensure that your change agents (people to whom you look to drive change) are your best and brightest, most charismatic and insightful. Provide this tool kit for starters and turn them loose!

Project 'Due Diligence' Questions

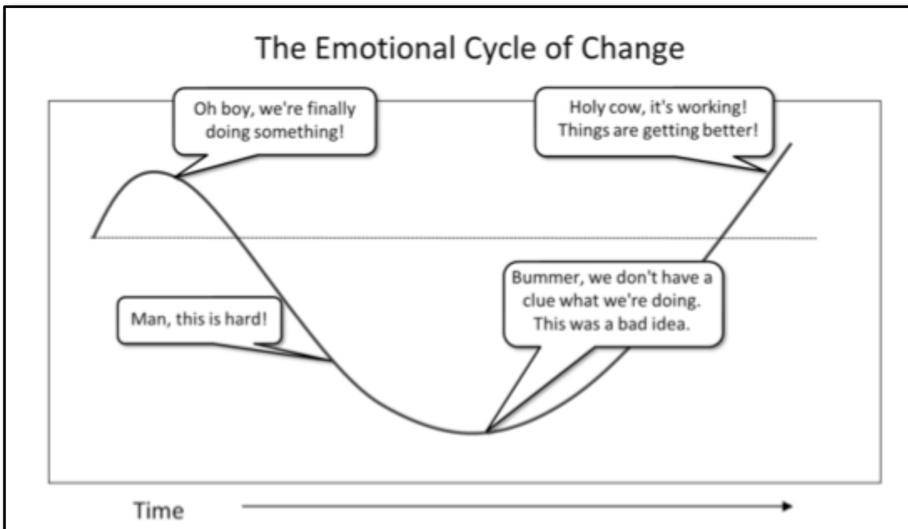
> Elevator Pitch
>
> "Ask due diligence questions (like these) up front, and resolve any issues raised before attempting ANY project. Always stack the deck for success."

While planning a business improvement project of any nature, executives should be asking questions such as:

- What is the rationale for the action?
- Who is accountable for the results?
- Who will be responsible for getting the work done?
- Who must be consulted before deciding or launching major changes?
- Who must be informed to make it work?
- What kind of information does your organization share in making decisions and coordinating its teams? How much openness is appropriate? How will you ensure confidentiality of critical information?
- For new products, can you demonstrate convincingly that there are customers willing to pay the prices you've assumed, in the volumes you've assumed?
- Do you have hard evidence - i.e., direct experience or solid industry data - that your cost and asset structures are reasonable?
- What are the risks of being wrong on any element? Have you quantified and mitigated those risks adequately?
- For consolidations, have you eliminated all internal sales and loans? Are all such sales and loans legitimate?
- Do your cash plans have any unusual assumptions about debt or equity markets? Are you absolutely certain cash will be available as needed? Are banks and stock markets receptive to funding companies like yours, and activities such as your scenario represents?

The Emotional Cycle of Change

Major change programs always generate strong feelings, sometimes even sufficient to cripple the program and generate disappointing results. It is a primary job of leaders, including executives and team leaders, to anticipate and counter the emotions, to keep the organization on an even keel.



At the outset, assuming the organization sees the program as positive and exciting; there will be unrealistic expectations for the new ‘silver bullet.’ Leaders need to help the team anticipate the battle ahead realistically.

When the hard work of change begins, leaders should focus the team on the long-term benefits, and how much better life will be when the improvements are in place.

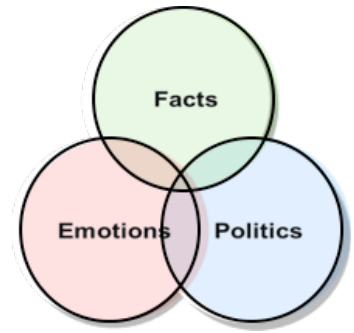
In most change programs, people are eventually worn down by hard work and limited near-term results. Leaders need to be cheerleaders, providing for early wins and interim rewards to maintain the focus.

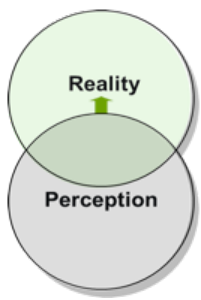
As improvements sink into daily work, organizations tend to become a little manic. It is important to celebrate the progress, but also to provide a sense of reality - It is never over!

Critical Success Factors

Facts - Emotions - Politics

The success or failure of every change project depends on how accurately the facts are perceived, how painful or pleasant the change will be, and how well it addresses the political positioning of all affected parties. This is a very complex aspect of business improvement, and closely related to two other significant success factors:



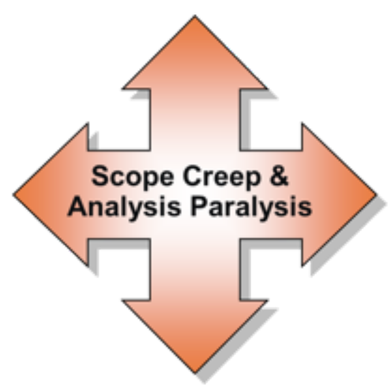


Perception vs. Reality

To be effective, a program must be fact-based and everyone with a significant role must be aligned. The view of current effectiveness must be accurately perceived, and the vision of the future must be realistic and fully embraced. Lack of alignment on the facts or their significance will stack the deck for failure.

Scope Creep & Analysis Paralysis

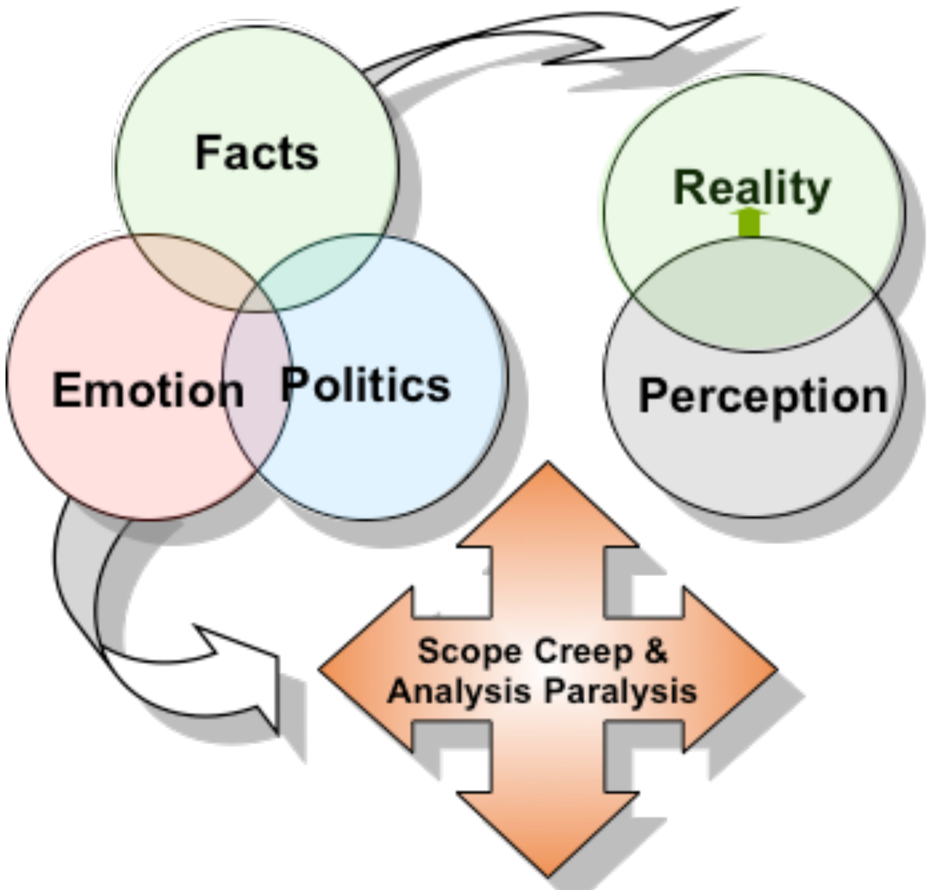
Projects of all types suffer from scope creep and analysis paralysis, generally driven by managers who lack experience with effective change programs. Scope creep refers to expanding the project to include organizational or process elements not originally included, and can be prevented by careful consideration of the analysis boundaries before launch. Analysis paralysis refers to expanding the data to cover every possible event, regardless of its material significance.



It is critical to consider these factors explicitly in planning any change. Many projects fail, often because these success factors were not adequately addressed.

The Soft Part is the Hard Part

The human side of creating valuable and lasting change is often more difficult than figuring out what to do, or even finding the money. The critical success factors described on the previous page are interrelated and require judgment and insight to apply masterfully. When in doubt, listen carefully. When not in doubt, listen even more carefully.



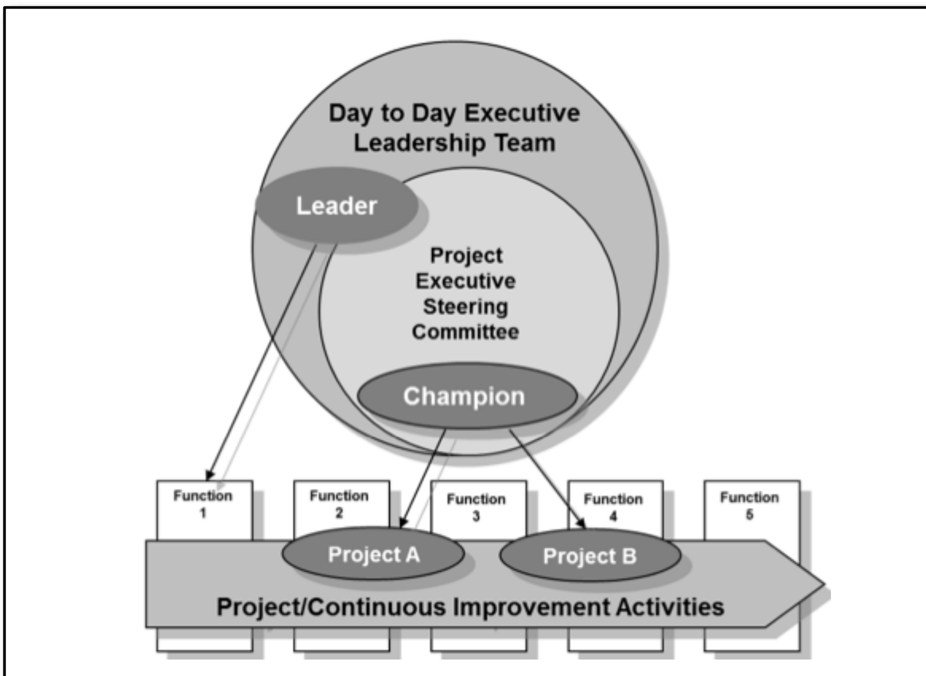
Executive Oversight

Elevator Pitch

"If the executives don't care, nobody cares."

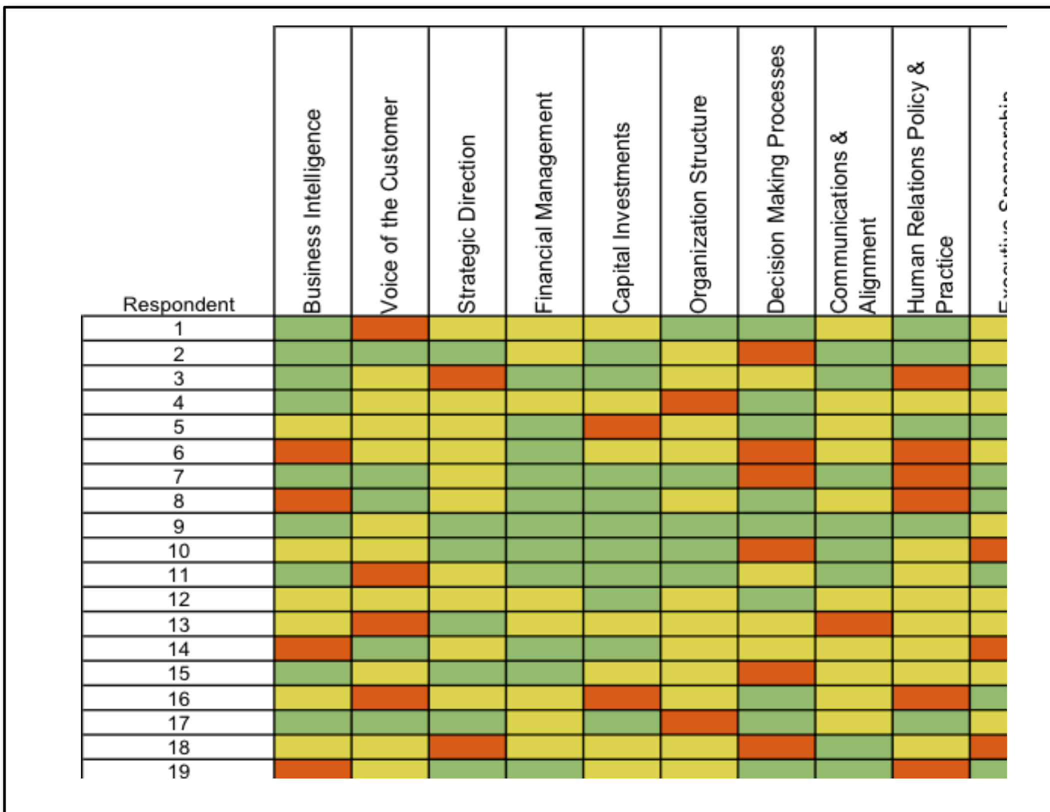
Project and continuous improvement governance are often assumed but not specifically addressed, and teams will rapidly lose focus if the executives do. It is critical that executives demonstrate their enthusiasm for this type of project in at least the following ways:

1. Regular, 100% attendance meetings of an Executive Steering Team to carefully review all progress against published schedules and cost and benefit expectations.
2. Direct frequent involvement in ongoing direction-setting advice, expert input, and barrier removal as champions for specific assigned work streams
3. Strategic direction setting, spending authorization, and resource assignments to ensure success of the overall effort and of specific efforts



Company Alignment Results

In this chart, based on ratings by each participant in the Vision Tool survey, black indicates significant disagreement with the other participants, light gray is some disagreement, and darker gray is general agreement. Significant disagreement about priorities can sabotage change efforts - there are many ways to resist change, and belief that a project is misdirected is a powerful incentive to resist. In the event that significant differences exist, it will be important to achieve consensus, especially among decision makers, before launching an improvement initiative.



Are They Ready for Change?

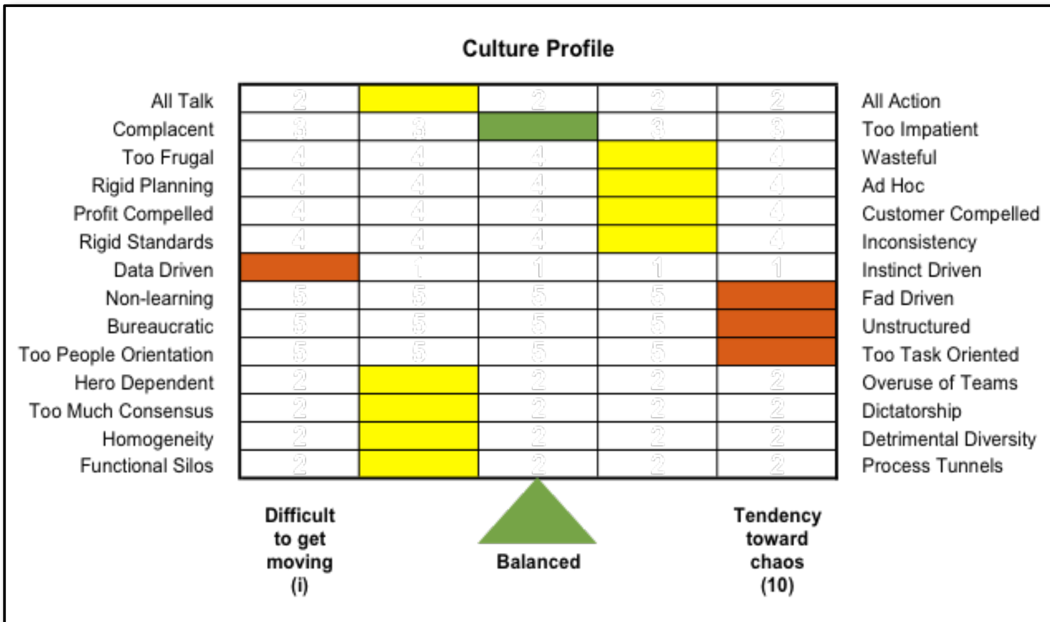
Oanizational culture will determine the success or failure of a change program. Some organizations isolate and destroy change agents and reject anything new; others are more adaptive. This quick survey provides a high-level view of change determinants. Few organizations will exhibit all of the tendencies at either the left (overly conservative) or the right (overly flexible) end of the scale, but a realistic view will help in positioning a change program for success. This survey appears in the available CD-ROM Surveys file, and a typical result chart appears on the next page.

"Rate your company along the following dimensions:"

	1	2	3	4	5	
All Talk						**All Action**
Complacent						**Too Impatient**
Too Frugal						**Wasteful**
Rigid Planning						**Ad Hoc**
Profit Compelled						**Customer Compelled**
Rigid Standards						**Inconsistency**
Data Driven						**Instinct Driven**
Non-learning						**Fad Driven**
Bureaucratic						**Unstructured**
Too People Orientation						**Too Task Oriented**
Hero Dependent						**Overuse of Teams**
Too Much Consensus						**Dictatorship**
Homogeneity						**Detrimental Diversity**
Functional Silos						**Process Tunnels**

Change Readiness Index

An organization with a healthy culture will tend to rate itself in the center of this Culture Profile chart, with few extreme traits. Extreme traits, when they do appear, need to be addressed to ensure the success of an improvement project. In fact, extreme traits may be detrimental in day-to-day operations and may be worthy of a change program in their own right.



Implementation of change is always a challenge, regardless of the clarity of the problem and its solution. Before launching an improvement program, review this simple checklist:

- ☐ Is there consensus on how the business is currently operating, and how it needs to operate to succeed? Does everyone understand this framework?
- ☐ Have problems (opportunities) been identified and clarified with facts? Is there consensus of all significant participants about what to work on?
- ☐ Has the organization created a program road map, business case, and charters and have all significant players bought in?

- ☐ Has the minefield of competing insights and personal interests, aspirations, and biases that make implementation so challenging been adequately addressed?

Notice that all of these improvement steps address the human aspect of change. That's because nothing happens unless and until people act. Even when change is a dire necessity – even a matter of survival – and even when the plan is flawless and elegant, it remains critical that the people affected buy in and drive it.

Case Discussion: Geezer Gear Clothiers

Geezer Gear Clothiers produce and market a broad line of stylish spandex and Velcro clothing for mature citizens. As a new hire in this family-owned company, you have been assigned by the CEO to organize a kaizen event to find out why an increasing number of employees are hanging out by the water cooler and production is lapsing. This is your first big break, as none of the mostly family executives have much insight into the operation and all are getting worried. You will get plenty of top-level exposure.

You have heard that the factory ‘drum’ is acting up, possibly due to lack of investment in maintenance and upgrades. In addition, inventory has begun to pile up around the factory to the point that aisles are partially blocked and specific items difficult to locate. People appear demoralized but not cynical.

1. What are your first concerns and considerations?
2. How would you set executive expectations?
3. How would you gain the trust of the employees?
4. How would you organize the event?

Geezer Gear Clothiers: Suggested Approach

Many students of business go right to the fact-based answers, suggesting fixing the 'drum' and getting the owners to do their jobs, for example, but this chapter and this case suggest focusing on the politics and emotions at least as diligently. To be successful (including, presumably, continued employment at Geezer Gear), consider the following	
Concerns and considerations	There is a lot of risk here. The answer may be that the family needs to invest, and they may be very emotional about their money. It is also possible the employees are bummed that the owners don't have a clue, and the 'drum' problem might be a work slow-down rather than a maintenance or machine capacity problem. Problems may be broader than just the drum, since executive leaders don't exert a strong and informed guiding hand. Get an inside mentor – the CEO, if possible – before attempting this assignment.
Executive expectations	Ensure there is a respected executive champion, to run interference and remove obstacles at the top. With his/ her support, set the expectation that you are going to organize the facts for review by a committee of executives, and that they are going to deal with emotional and political realities.
Employee trust	You need more insight into employee attitudes through such means as informal discussions and brainstorming sessions. From the start, demonstrate your comfort with lean and Six Sigma concepts and tools, especially root cause analysis, Pareto analysis, 5S, line balancing and kanban management, which appear to be important themes here. The employees need to have confidence that you will lead them to safety.
Kaizen organization	Use the Kaizen checklist and related tools in this book to organize the event. Ensure especially that: o The timing is right (don't jump in until you have stacked the deck for success) o You have the right team (and especially the right financial analyst) You have the right scope (this one may want to creep)


Geezer Gear®
For Senior Citizens on the Go

NOTES:

Strategy Considerations

Securing Income

Every organization has a strategy, whether conscious or not, and a key element of every strategy is financial stability and growth. Therefore, every organization – for-profit, non-profit, or government, and delivering goods or services – needs a source of income to survive. While the sources and uses of these funds vary, the science and methods behind strategies for securing funds are very similar.

> Elevator Pitch
>
> "A fundamental element of every strategy for every organization involves getting money."

Marketing studies what products are needed, who will buy them, and how and where you will find these buyers. In the case of for-profit companies, marketing strategies are generally straightforward, based on analysis of existing marketplaces and competition and supported by analysis of the costs to produce goods and services and the value these goods and services bring to customers. For non-profits, the marketing appeal is to philanthropists and government agencies, and the value offered consists of non-financial benefits. For government agencies, marketing focuses on the politicians who set budgets and the public that elects the politicians.

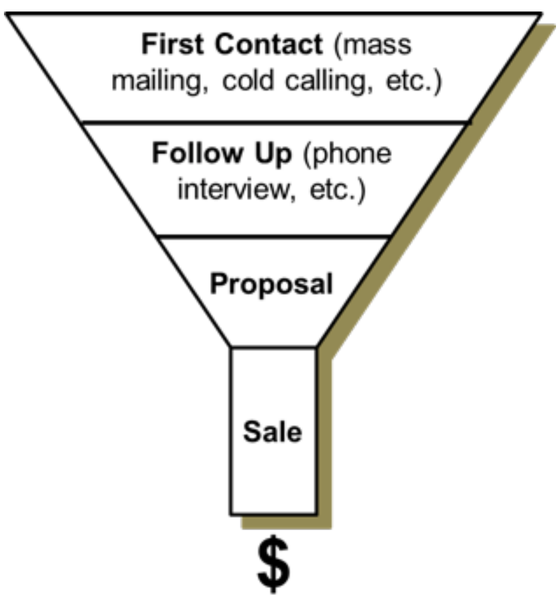
Selling considers the process steps needed to reach prospects and entice them to buy, applying resources and advertising/promotion dollars to the sales process in accordance with the marketing strategy. For non-profits, this entails mailings and events to attract donors. For government agencies, selling is accomplished by publicizing positive accomplishments (and spinning negative ones!) and lobbying political figures.

Using the Sales Funnel

Elevator Pitch
"A sales funnel tracks sales activities from the first contact until money changes hands."

Selling is often seen as a dark art, based more on intuition and personal relationships than on science. At one level that is true; people like to buy from people they like, and there is strong emotional content in every significant sale. But many organizations have demonstrated the value of a scientific approach in their sales strategies, tracking customers through a sales process "funnel" from first contact through the sale. Using simple statistics, each step of the process is measured and refined.

For example, a company selling airplanes could advertise in a magazine read by pilots, then track the number of inquiries referencing that magazine and compare that number with the magazine's circulation or the cost of advertising to calculate the efficiency of that source. They could then track each inquiry, assigning (and measuring) a salesperson at each step in their sales process.



For another example, a consulting firm could use telemarketers to contact CEOs. Of the percentages who express interest, in-depth phone discussions or introductory meetings might identify a few of that number who would pay for an analysis, and a few of those might buy full-blown consulting services. Focus on the list of prospects at each step in this process, and estimates of the sales amounts and probabilities, would help in forecasting sales and assigning sales resources for maximum impact.

Marketing Strategies

> **Elevator Pitch**
> "Marketing finds the buyers. Selling finds their money."

According to Michael Porter, the Harvard Business School marketing guru, there are three strategies for entering the market:

1. Be the low cost supplier, focusing on either
   a. Customers looking for the lowest price, or
   b. Customers looking for the best value (lowest price for quality products)
2. Offer differentiated products and services (quality, features, etc.) with premium pricing
3. Focus on a market niche serving
   a. Customers looking for the lowest price, or
   b. Customers looking for best value (lowest price for quality products) [15]

For example, K-Mart could be considered type 1a, with off-brands at low prices, while Marshall's may be considered type 1b, with name brands at rock-bottom prices. These low cost strategies often co-exist, as at WalMart, with name brands at low prices as well as off-brands at even lower prices.

Differentiation (offering unique products / services) can allow premium pricing unless or until competition arises. For example, IBM owned most of the computer market for years after it introduced the general purpose 360 computer in 1965.

Focus creates products for a market niche that might be too small or difficult to enter or non-strategic for competitors to care about. Manufacturing throw-away Halloween costumes would be a low-cost (3a) niche, and concrete garden ornaments a best value (3b) niche. Like cost leadership strategies, the lines between low-cost and value niches are often blurred at the retail level.

Most non-profits offer differentiated services, providing goods and services to particular beneficiaries in unique ways. Some non-profits in competitive "markets" (such as environmental services and child welfare, with many providers competing for support dollars) stress their efficiency as well. to gain political support to continue their existence. Government organizations – generally monopolies – rely on differentiated services to gain political support to continue their existence.

Marketing Mix: The Four P's

Elevator Pitch

"To make a sale, get the right PRODUCT at the right PRICE in the right PLACE with the right PROMOTION."

The "Four P's" of marketing is a widely used concept applied as market plans are created. The marketing mix can be fluid as product, pricing, placement, and promotion decisions influence each other to optimize earning potential. For example, a decision to add features to an automobile directly affects the price (to cover costs) and the way to promote it for maximum impact. It can also affect placement, as features may apply to a specific geography or demographic. In every case, these decisions start with customer needs and consider competing offerings to arrive at the optimum mix.

An effective marketing program addresses the "FOUR P's of MARKETING":	
1. PRODUCT	goods and services must meet the needs of potential customers
2. PRICE	Prices must represent a competitive value from a customer perspective that also provides an appropriate profit to the organization
3. PLACE	Products must be located where customers can find them
4. PROMOTION	collateral material and activities must be created to draw attention to the product.

In an increasingly complex world, with a growing service economy and the impact of the Internet, the "Four P's" could be expanded to ensure important significant emerging factors are considered, as illustrated below:

For services, you also need to address:	
5. PEOPLE	the quality of a service is totally in the hands of the employees who deal with customers
6. PROCESS	service delivery, with direct customer interaction, must be effective and efficient
7. PHYSICAL EVIDENCE	buyers need to "see" what they are buying (e.g., samples of finished work such as reports, charts, and schematics)

And in the Internet age, there are even more suggested "P"s":	
8. PERSONALIZATION	increasingly flexible order configuration and production tools have raised customer expectations: they want exactly what's needed when needed
9. PARTICIPATION	customers offer feedback and join conversations to help specify what they are looking for
10. PEER-TO-PEER	customer networks provide insights into product issues and expectations
11. PREDICTIVE MODELLING	data mines are used for a variety of analyses, including estimates of future demand in geographic and demographic segments

Fixing Services

> **Elevator Pitch**
> "Lean and six sigma tools and techniques apply to production of services (such as paperwork management) as well as production of goods."

This book was written with business improvement strategies for manufacturing of physical products in mind, but these strategies apply equally well to delivery of services, which must also meet customer quality requirements and be delivered efficiently.

Lean / Six Sigma

The tools and techniques of lean and six sigma can be applied in any setting with repetitive work. For example, a bank may handle millions of transactions per month or year, and all must be efficiently handled and accurate.

In this banking example, the lean approach would focus on eliminating wasted motion and resources by such techniques as:

- Streamlining decision processes using electronic signatures
- Simplifying and error-proofing data entry forms
- Aligning resources with the demand for transactions (pull philosophy)

Six sigma would focus on delivering what customers demand by:

- Establishing specifications for transactions and statistically analyzing aberrations
- Following disciplined processes to correct root causes of problems

Financial Management

This book illustrates the Income Statement with a manufacturing example, with the Cost of Goods Sold composed of direct material and direct labor plus factory overhead. Services do not necessarily include materials or factory overhead, but it is still critical to understand the costs associated with sales. In the banking example above, costs are driven by staff, office supplies, and infrastructure (such as computer systems) used to produce finished transactions.

Business Case

Investments in process design, even without any physical asset investments, can be very expensive. Business cases involving intangibles are even more important to structure and track, because the results of the investment can be difficult to observe compared to, say, a new piece of production equipment.

Project Management

Similarly, projects involving intangibles require special attention because invisible milestones can be more difficult to track and measure than installed physical assets.

Fixing Non-Profits

Elevator Pitch

"Non-profit doesn't mean financially illiterate, but business improvement skills are often lacking."

Non-profit organizations' strategies are focused on providing beneficial goods and services without worrying about profits for shareholders. Nonetheless, they do worry about funding, and need reasonably efficient operations that provide the quality their benefactors require in order to survive. To date, few non-profits have engaged in the lean and six sigma practices that would ensure effectiveness and efficiency, for several reasons:

- Funding is applied to their main mission as much as possible, limiting their funding for business improvement investments
- Leaders are often selected for their commitment to the cause, not their technical business acumen
- Lower than average compensation, and volunteer cadres, limit the number of skilled business professionals in the non-profit field
- Many non-profits are in niches with limited competition and die-hard supporters

It is possible, though, that a weakening economy could force non-profits to consolidate and focus more on efficiency.

Fixing Government

Government organization strategies are focused on providing goods and services for the public good, but they also have fiscal accountability –they must not run out of money.

Elevator Pitch

"We all wish government agencies paid attention to finances as well as for-profit businesses."

This sometimes results in the counter-intuitive (to a business person) practice of burning through the budget at the end of a fiscal year in order to secure the same budget in the following year, a highly inefficient practice.Like non-profits, government agencies do not generally apply lean and six sigma practices that would improve effectiveness and efficiency, but for different reasons:

- Funding is sometimes negatively impacted by efficiency – more efficiency may result in budget cuts
- Leaders are often selected for their political connections, not their technical business acumen
- Government workers often spend more time dealing with red tape and political issues than with managing and improving business operations

NOTES:

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And, despite its oft-sullied reputation in academia, Wikipedia, an outstanding resource for most business analysis concepts!

Continuous Improvement Glossary

3

3P

Production Preparation Process. Rapidly designing production processes and equipment to ensure capability, built-in quality, productivity, and Takt-Flow-Pull. The Production Preparation Process minimizes resources needed such as capital, tooling, space, inventory, and time.

3Ds

Working conditions or jobs that are Dirty, Dangerous, or Difficult.

3 Elements of Demand

Customers look for Quality, Cost, and Delivery.

3 Principles of Kaizen

1. Go to the shop floor (gemba),
2. Work with the actual product (gembutsu), and
3. Get the facts (genjitsu).

3 Elements of Just In Time (JIT)

1. Takt time
2. Flow production, and
3. The downstream pull system.

4

Crosby's 4 Absolutes

1. The definition of quality is conformance to requirements (10% to specs, 90% to customer requirements)
2. The system for causing quality is called 'prevention'
3. The performance standard for quality is zero defects
4. The measurement of quality is the price ofnonconformance

5

5Ms of Production

Man, Machine, Material, Method, and Measure.

5S Principles

Bias toward neat and clean workplace.

1. Sort (seiri – organize)
2. Straighten or simplify (seiton – arrange)
3. Sweep or scrub (seiso – clean)
4. Standardize (seiketsu – consistent organization / methods)
5. Self-discipline or sustain (shitsuke – make 5S a habit).

5 Whys

Find the root cause of problems by asking `why?' five times (or as often as necessary) for causes of causes

7

7 Production Wastes

Taiichi Ohno1s original catalog of the wastes commonly found in physical production are:
1. Overproduction (ahead of demand)
2. Transportation (unnecessary transport of materials)
3. Motion (over processing of parts due to poor tool and
product design),
4. Waiting (for the next processing stop)
5. Processing (unnecessary movement by employees
during the course of their work)
6. Inventory (more than the absolute minimum), and
7. Defects (production of defective parts).

10

Juran's 10 Directives for Management

1. Build awareness for the need and opportunity for improvement
2. Set goals for improvement
3. Organize people to reach the goals
4. Provide training throughout the organization
5. Carry out projects to solve problems
6. Report progress
7. Give recognition
8. Communicate goals
9. Keep score
10. Maintain momentum by making annual improvement part of the regular systems and processes of the company

14

Deming's 14 Points

1. Create constancy of purpose
2. Adopt the new philosophy (of quality)
3. Cease dependence on mass inspection to achieve
quality
4. End the practice of awarding business on the basis of
price alone
5. Improve constantly and forever the system of production and service
6. Institute training on the job
7. Institute leadership
8. Drive out fear
9. Break down barriers between departments
10. Eliminate slogans, exhortations, and targets for the
work force
11. Eliminate work standards on the factory floor and eliminate management by objectives as practiced
12. Remove barriers that rob employees of pride of workmanship
13. Institute a vigorous program of education and self-improvement
14. Put everybody to work to accomplish thetransformation

Crosby's 14 Points

1. Management commitment
2. Quality improvement trams
3. Measurement
4. Cost of Quality (COQ)
5. Quality awareness
6. Corrective action
7. Zero defects planning
8. Employee education
9. Zero defects day
10. Goal setting
11. Error cause removal
12. Recognition
13. Quality councils
14. Do it all over again

A

Abnormality Management

Being able to see and quickly take action to correct abnormalities (any straying from Standard Work). This is the goal of standardization and visual management. Continuous waste elimination and problem solving through kaizen are only possible when the abnormalities are visible.

Absorption

Fixed costs are the costs of being in business, as opposed to the cost of doing business. Under normal circumstances, these costs continue at the same rate regardless of sales volume generated. Such costs are paid, like everything else, out of revenue and are conceptually absorbed by the goods and services produced. If fewer goods and services are produced, each unit will have to absorb more of the fixed costs.

Activity Based Costing (ABC)

An analytical accounting tool that assigns otherwise allocated costs to products / customers based directly on the resources used to produce / serve them.

Acid Test

An extreme version of the Current Ratio, the "Acid Test" assumes Inventory cannot be converted to cash.

Affinity Diagram

A visual display of cards with random ideas grouped by topic under heading cards to provide insights into areas for focus.

Andon Board

A visual control device in a production area, typically a lighted overhead display or board, giving the current status of the production system and alerting team members to emerging problems or abnormal situations.

Asset Leverage
Use of assets to gain the optimum revenue (measured as Revenue divided by Assets).

Autonomation
Semi-automatic processes where operators and machines work together as production partners.

B

Back flush
The process of automatically decrementing perpetual inventory records, based on the bill of materials of a given product and shipment records. Back flushing eliminates some complex inventory valuation procedures.

Balance Sheet
Standard financial statement that presents assets, liabilities, and equity as of the end of one or more fiscal periods. This statement describes what is owned (assets) and who owns them (creditors, in the case of liabilities, or owners in the case of equity).

Balanced Plant
A plant where resource capacities are balanced with market demand

Balanced Scorecard
A system of metrics that summarizes significant data, ensuring executives are looking at customer needs, financial performance, efficiency, employee indicators, and investments in the future in a balanced way.

Balanced Production
All operations or cells produce in the same cycle time, at or less than Takt time.

Batch Production
A 'Push' system of production where resources are provided to the consumer based on forecasts or schedules. This may be driven by time-consuming / expensive set-up or start-up procedures.

Batch-and-Queue
Producing more than one piece of an item and then moving those items forward to the next operation before that are all actually needed there. Thus, items need to wait in a queue.

Benchmarking
The process of measuring products, services, and practices against those of leading companies.

Best-in-Class
A best-known example of performance in a particular operation. One needs to define both the class and the operation to avoid using the term loosely.

Black Belt
Title given to a highly qualified process improvement facilitator, particularly associated with experienced Six Sigma team members at GE and its emulators.

Blitz
A fast and focused process for improving some component of business.

Breakeven
Breakeven Analysis involves computation of the point at which profit contribution (revenue minus variable cost) exactly equals the fixed costs of a company.

Breakthrough Objectives
Imaginative, stretch objectives providing significant competitive advantages and requiring significant change in an organization.

Brownfield
An existing and operating production facility.

Bottleneck
Anything that limits the throughput of a process.

Business Model
A description of how a company means to serve its customers, and earn money, including its strategy (what it will do) and its implementation concepts (how it will do it).

C

Cannibalization
This occurs when a new product takes some of its market share from its owner's existing products, in effect cannibalizing other planned revenue.

Capitalization
Investments in systems, machinery and equipment, or people-related costs if their work results in an amortized asset (such as software).

Carrying Cost
Carrying Cost generally refers to the costs of "carrying" (holding) inventory, including the financial costs of (interest on) cash that is invested in inventory plus typical warehousing costs, often expressed as a per cent of inventory value.

Cash Flow / Funds Flow Statement
Standard financial statement that shows how cash was obtained and used in one or more fiscal periods.

Catch-Ball
A series of discussion between managers and their employees during which data, ideas, and analysis are thrown like a ball. This opens productive dialogue throughout the entire company.

Cause and Effect Diagram
A problem-solving tool used to establish relationships between effects and multiple causes and sub-causes. Also known as an 'Ishikawa' or 'fishbone' diagram.

CEDAC
An acronym for 'Cause and Effect Diagram with the Addition of Cards.' Problem solving team members are given note cards to capture and array their thoughts.

Cells
Semi-autonomous and multi-skilled teams who manufacture complete products or complex components in one location.

Cellular Manufacturing / Cells
Grouping work to take advantage of the similarity between parts through standardization and common processing.

Chaku-Chaku
A production line where the operator loads the part into the first machine and it is automatically passed from one machine to the next without operator involvement.

Change Agent
An individual who sees and brings to reality a new way of doing business.

Changeover
The installation of a different tool, mold, die, or control program in a production machine (such as a lathe or milling machine, injection molding machine, or painting system).

Chart Of Accounts
A hierarchical numerical index of financial elements designed for sub-totaling financial transactions into meaningful categories.

Consolidation (of Businesses)
Consolidation refers to combining two or more business entities, taking into account their existing interactions to prevent certain transactions from being double-counted.

Constraint
Anything that limits a system from achieving higher performance or throughput.

Contingency Planning
Planning for actions to mitigate risks.

Continuous Flow Production
Production where pieces are completed one at a time in a continuous sequence. Each process makes only the one piece that the next process needs, and the transfer batch size is one.

Continuous Improvement Process (CIP)
The never-ending process of improving quality and / or eliminating waste within an organization.

Control Chart
A statistical tool tracking a process to ensure it functions to produce output within established limits.

Control Element
A specific process variable which must be controlled in an experiment.

Counter measures
Immediate actions taken to bring performance that is tracking below expectations back into the proper trend.

Counterclockwise flow
Traditional manufacturing cell layout drives the flow of material, and the motion of people, from right to left, or counterclockwise (said to originate from the design of tools with chucks on the left side, making it easier for right- handed people to load from right to left).

Covariance
A measure of the strength of correlation between two or more random variables.

Currency Conversion
Translation of the value of one country's currency into another, using current or projected exchange rates.

Current Ratio
Current Assets divided by Current Liabilities, a measure of liquidity, or the ability to pay current debts out of

current assets.

Current State Map
A schematic illustrating a current process

Curtain effect
A method that permits the uninterrupted flow of production regardless of external process location or cycle time. Normally used when product must leave the cell for processing through equipment that cannot be put into the cell. (i.e. heat treat, curing oven, plating, wave solder) Curtain quantities are established using the following formula:
Per unit Cycle Time of Curtain Process / Takt Time =
Curtain Quantity.

Cycle Time
The time required to complete one cycle of an operation.

D

Daily Management
Attention each day to those issues concerned with the normal operation of a business.

Days Sales Outstanding (DSO)
A measure of Accounts Receivable, measured as A/R divided by annual Revenue, times 365. How many days we wait after delivering a product to get paid for it.

Days' supply of inventory
Total number of days (if the production level equals zero) that it would take to deplete finished goods inventory for the specified product line.

Debt / Equity Ratio
Total Liabilities divided by Total Equity, indicating the balance of the stakes held between owners and creditors.

Dependent Events
Events that occur only after a previous event.

Discount Rate
The rate of interest assumed to represent the current cost of money.

Discounted Cash Flow
An evaluation of a cash stream that devalues future cash flow in today's currency based on the time value of money concept.

Dividend Yield
The value of Dividends paid compared to the Market Value of a stock.

E

EBITDA

(Earnings before Interest, Taxes, Depreciation, and Amortization) is a measure commonly used by investors to understand a company's ability to incur and service debt.

EOQ (Economic Order Quantity)

EOQ is the right amount of an item to order to minimize the trade-off between ordering costs and the carrying cost of inventory.

Enterprise Software or Enterprise Resource Planning (ERP) Software

ERP systems or integrated Best of Breed systems with powerful middleware can support all of the communications needed for smooth operations throughout an organization. However, MRP (Manufacturing Resource Planning) systems that attempt to drive production may in fact be a barrier to lean, and build wasteful WIP (Work in Process) inventory.

Error Proofing

Designing a cause of potential failure, or a hazard to safety, out of a product or process.

Every Part Every

'Every Product Every (hours, day, week, month)' indicates the flexibility to produce whatever the customer needs. For instance, Every Product Every day would indicate that changeovers for all products required can be performed each day and the products can be supplied to the customer.

F

Fixed Cost

This refers to costs that don't change with changes in Revenue.

Financial Statements

Financial statements have evolved over the years to show in standard, easy to read format what a company owns and owes, whether it is making or losing money, and whether its cash flow is positive or negative. The three general forms of financial statements are:

1. Balance Sheet
2. Profit & Loss (P&L) also called the Income Statement
3. Cash Flow / Funds Flow Statement

Fiscal Year

The twelve month period, starting any month that a company uses to plan, budget, and report its business.

Flow

Movement of product continuously from raw material to finished goods through a production system that acts as one long conveyor.

Flow Chart
A schematic chart that illustrates a process, sometimes showing the ‘as is’ and ‘to be’ processes for comparison, identifying wasteful steps.

Flow Production
Production designed to pull product from operation to operation in the smallest increment (ideally one piece at a time).

Functional Layout
The practice of grouping machines or activities by type of operation performed.

Future State Map
A blueprint for a ‘to be’ process.

G

Gain Sharing
An approach to providing incentives for team success, such as a share of the cost reduction or revenue increase.

Gemba
Japanese word for ‘real place,’ the actual shop floor where production occurs.

Gembutsu
Japanese for 'actual thing' or 'actual product,’ the tools, materials, machines, parts, and fixtures that are the focus of kaizen activity.

Genjitsu
Japanese for 'the facts' or 'the reality,' applied to the shop floor / the business.

Genchi Genbutsu
Japanese for ‘see for yourself,’ without relying on reports from a distance.

Greenfield
A new production facility.

Gross Profit Margin
Gross Profit is the contribution made toward corporate expenses by the sale of products, calculated as a percentage: Revenue – Cost of Goods Sold / Revenue.

H

Hanedashi
A device for automatically off-loading a work piece from a machine when it is finished at that machine, essential for a ‘Chaku-Chaku’ line.

Heijunka
Japanese for ‘leveling.’ The concept is applied to production in small batches at final assembly, enabling JIT and other

lean practices. This is particularly beneficial on a mixed-model production line.

High Performance Teams
Teams that perform complex tasks correctly and quickly.

Histogram
A chart that displays a series of metrics (x axis) according to the frequency of each (y axis) in order to understand variations. With enough data points this may result in a standard curve.

Hoshin Kanri / Hoshin Planning
A tool for linking long-term goals to daily activities by clarifying strategies that support the goals, critical success factors that enable the strategies, and core competencies that make the critical success factors possible. Generally created by the senior management team and aligning people at all levels. (Hoshin Kanri means 'Direction Management')

Hurdle Rate
This refers to an organization's minimum rate of return required of all investments. If the estimated return falls below that rate, the investment will be rejected.

I

Ijo-kanri
Being able to see and quickly take action to correct abnormalities.

Income Statement
Standard financial statement that presents revenue, costs, and the resulting profits for one or more fiscal periods. (Also called the P&L Statement.)

Insourcing and Outsourcing
Contract with an outside source to purchase goods or services previously produced in-house / produce in-house goods or services that were previously purchased outside.

Integrated Product Development
Refers to processes that bring engineering, marketing, financial, and production experts together to design and introduce new products.

Internal Growth Rate
The maximum growth rate achievable without external financing of any kind.

Internal Rate of Return (IRR)
Internal Rate of Return refers to the rate of return calculated directly from the cash outflows and inflows of that project.

Inventory

Inventory includes all raw materials, purchased parts, work-in-process, and finished goods not yet purchased. Consumable production supplies may also be accounted as inventory.

Inventory Turns

A measure of how often inventory is completely replenished in a given period (usually a year).

J

Jidoka

'Autonomation' allows a machine to stop instantly if it detects defects.

Jishuken

Lower level management driven focus identifying kaizen opportunities.

Just-in-Time (JIT)

A system for producing and delivering the right items to the right place at the right time, in the right amounts. 'Just- in-Time' requires focus on balanced flow, pull procedures, standard work, and Takt time.

K

Kaizen

Japanese for little fixes, generally applied to team efforts of a few days (Kaizen Blitz) to rapidly analyze and improve processes or sub- processes.

Kanban

A signaling device, often 'low tech,' which orders parts to be produced and delivered in a pull system.

L

Lead Time

The time a customer must wait for an order to be filled. This applies also to a process on a production line waiting for work pieces to arrive.

Lean

Business processes requiring less human effort, capital investment, floor space, materials, and time in all aspects of operation.

Life Cycle

Product life is measured from development, through sales growth and decline, to eventual exit and disposal.

Liquidity

Ease and speed with which an asset can be converted to cash.

M

Mergers And Acquisitions

Business combinations involving purchases or stock swaps.

Marginal Tax Rate

Tax payable on the next taxable dollar

earned.

Mistake Proofing
Any equipment or procedure change to an operation that helps the operator reduce or eliminate errors.

Muda
Japanese for waste, applied to anything that interferes with the value stream.

Multi-Skilled Worker
Associates at any organizational level with diverse skills, providing flexibility in a production process.

Mura
Japanese for unevenness, as in an unbalanced production line, solved through kanbans.

Muri
Japanese for overburden, unreasonableness or absurdity.

N

Net Present Value (NPV)
Net Present Value is a calculated estimate of the value of an investment's cash outflows and inflows over the life of the investment.

Non-Value Added
Activities that add no customer demanded value to a product or service.

One Piece Flow
Operators transfer each item individually to the next process step.

O

Operating Cycle
The number of days from the time money is spent until it is collected, from the purchases that go into inventory to the collection of receivables.

Operating Expenses
The money required for the organization to be in the business, making product and supporting the operation.

Opportunity Costs
Opportunity Cost is the cost of NOT gaining an alternative financial benefit of an investment.

Other People's Money (OPM)
Funds raised from sources other than the owners. The term OPM is sometimes used to describe seed money provided by "Angels" or "Friends and Family" investors to start a new venture.

Out Of Pocket (OOP)
Out of Pocket costs are investment costs that require cash or cash equivalents.

Overproduction
Producing more, sooner or faster than is required by the next process.

P

Payback
A measure of how long until the income from an investment covers the cash outflow.

PDCA (Plan, Do, Check, Act)
A logical sequence for fixing any problem, unfortunately frequently forgotten.
PLAN: Analyze the problem and develop an appropriate plan of action, specifying who, what, where, when, and how and the expected benefits.
DO: Perform the actions.
CHECK: Review the measurements to ensure benefits are on track.
ACT: Redirect efforts as necessary.

Pareto Chart
A vertical bar graph showing the frequency of causes of error in descending order, generally indicating that a few causes are most frequent (the 80/20 rule).

Peer Group
Firms with similar assets, operations, and markets.

Perfection
An unattainable goal approached by optimizing value- added activities

Poka-Yoke
Error / mistake proofing using devices or procedures to prevent inefficient or unsafe actions. For examples, in-line weighing would prevent out of spec parts from proceeding to the next step, and safety gates would keep hands out of dangerous machines.

Price/Earnings (P/E) Ratio
The value of a stock expressed as a multiple of a company's earnings.

Price Sensitivity
Price usually has an impact on demand. Often when prices are reduced, the volume of goods sold increases. Higher prices may decrease the volume.

Pro Forma Financial Statement
a financial statement which projects future years' operations

Process
Operations that transform material (or paperwork) from input to finished product.

Process Kaizen
Improvements made at an individual process or in a specific area. Sometimes called 'point kaizen.'

Process Reengineering
Integrated restructuring of operations to improve effectiveness and efficiency.

Process Map
A visual representation of the sequential flow of a process to identify opportunities for improvement.

Processing Time
The time a product is actually being worked on in a machine or work area

Profit & Loss (P&L) Statement
Standard financial statement that presents revenue, costs, and the resulting profits for one or more fiscal periods. (Also called the Income Statement.)

Profit Margin
Profit Margin is a percentage calculated as Net Profit after Tax divided by Revenue.

Pull
A system of cascading production and delivery instructions from downstream to upstream activities in which the upstream supplier waits until the downstream customer signals a need.

Pull System
Product is pulled through a process, starting with the end user. A sale triggers production of another unit, production of the unit triggers suppliers to send sub-assemblies or raw materials, and so on. Very little excess inventory is created.

Push System
Product is pushed into a process, regardless of whether it is needed, often creating excess inventory.

Q

Quality Function Deployment (QFD)
A visual decision-making tool for cross-functional project teams that focuses on the voice of the customer, addresses product performance targets and trade-offs, and develops consensus and team commitment to product specifications. QFD reduces expensive rework as projects near launch.

Quality Management
The organizations, practices, and tools that make it possible to plan, manufacture, and deliver quality products / services.

Quick Changeover
Rapid change of tooling / fixtures when multiple products run on the same machine.

Queue Time
The time a product spends in a line awaiting the next design, order

R

RACI

Responsible-Accountable-Consulted-Informed – descriptions of Roles and Responsibilities, to be analyzed and clarified as needed

Reengineering

Fundamentally revising integrated processes throughout a company to improve quality and efficiently.

Resource Utilization

Using a resource for any purpose (preferably to add value).

ROI (Return On Investment)

Whenever an investment is made, the investor needs to understand when and how it will be recovered and how much it will eventually return.

ROIC (Return On Invested Capital)

after-tax earnings on the average assets employed

S

Sensei

A master / teacher who helps implement lean or Six Sigma practices. The term was originally applied in Oriental martial arts.

Sequential Changeover

Changeover / setup of machines within Takt time so that multiple products can be made on the same line without interrupting the flow.

Scenario Analysis

An analysis based on a specific set of conditions. Generally several scenarios will be generated to compare the effects of "what if" situations.

Sensitivity Analysis

Analysis of the effect that a single variable has on the ROI of an investment.

Shareholder Value

The market value of a company's stock divided by the book value of the company, representing the premium stock purchasers are willing to pay for the assets of the company under its current management.

Single Minute Exchange of Dies (SMED)

Concept of rapid machine changeover / setup to keep production flowing with minimal downtime when multiple products run on the same machine. Ideally changeover would be instantaneous and would not interfere with continuous flow.

Single-Piece Flow

A production process in which products are pulled through production one complete product at a time.

Standards
Accepted norms, often set by regulatory organizations.

Standard Work
A precise description of each work activity specifying cycle time, Takt time, the work sequence of specific tasks, and the minimum inventory of parts on hand needed to conduct the activity.

Standard Work in Process
The minimum amount of material for a given product which must be in process at any time to ensure proper flow of the operation.

Sunk Cost
A sunk cost is a cost already incurred (paid or obligated), and therefore not relevant to an investment decision.

Standardization
Use of uniform methods and processes to ensure uniform output

Supplier Partnership
Close working relationship with a supplier to gain mutual benefits, such as more revenue or less cost through better designs, logistics, etc.

Sustainable Growth Rate
The maximum growth rate achievable maintaining a constant debt-equity ratio without external equity financing.

System Kaizen
Improvement aimed at an entire value stream

Sub-Optimization
Taking action to improve efficiency in one area that negatively impacts the efficiency of another area even more.

T

Takt Time
The available production time divided by the rate of customer demand. For example, if customers demand 480 automobiles per 480 minute shift, Takt time is one minute.

Team Oriented Problem Solving
Many tools and techniques of continuous improvement are designed to help teams focus on and resolve problems.

Theory of Constraints
A lean management philosophy focused on removing constraints to increase throughput and decrease inventory / expenses.

Throughput Time

Throughput Time
The time required by a process to complete its value- adding activities.
Total Productive Maintenance (TPM)
A disciplined integration of maintenance schedules with production schedules in order to prevent unplanned down time and gain optimum run time from every significant machine.

Toyota Production System (TPS)
A manufacturing philosophy that relentlessly attacks waste while improving quality and shortening work cycles

V

Value
The right product (defined by the customer) at the right price (defined by the competition).

Value-Added Analysis
Analysis of activities to determine which add value from the customer's perspective in order to eliminate non-value adding activities (wasted effort).

Value Stream / Value Chain
The progressive sequential activities that add value to a product –material management, fabrication, logistics, etc. – from raw material to finished product.

Value Stream Mapping
Creating a schematic of how material gains value as it moves through an operation in order to identify opportunities to eliminate waste.

Variable Cost
Cost that varies directly with the number of units produced.

Vertical Teams
Teams that include employees from multiple organizational levels.

Vision
A long-term view of what the company is and aspires to in terms of its business model, systems for management, and processes.

Visual Control
Information, parts, and tools displayed for instant understanding of the process or system status.

Voice of the Customer (VOC)
Establishing product /service designs and features based on carefully listening to what the customer wants and needs.

W

Waste
Anything produced that has no value; any use of resources that produces nothing of

value.

Work in Progress (WIP)
Product or inventory in various stages of completion throughout the plant, once released as raw material to the floor and before becoming finished goods ready for shipment.

Work Sequence
The order in which work steps occur.

Working Capital
The funds invested to support day to day operations of a business.

World Class
An overused term meaning ‘done as well as the best in the world.’

Y

Yokoten
Duplicating the results of a kaizen event.

Yield
Per cent of material and labor input that becomes acceptable finished product.

Z

Zero-Based Budgeting
A budget built from scratch, replacing justification based on historical spending with justification based on requirements of current value-adding activities.