LEAN LEADERSHIP: 22 ATTRIBUTES OF SUCCESSFUL BUSINESS EXECUTIVES, DIRECTORS, AND MANAGERS

Lea·der·ship (*lē'dər-shĭp'*) is one or more people who direct, manage, supervise, guide, shepherd, influence, motivate, inspire, or control organizations, enterprises, agencies, entities, firms, business units, portfolios, programs, projects, teams, and individuals. Leaders tend to have significant attributes of wealth, resources, intelligence, training, education, experience, track record, skills, confidence, courage, authority, power, motivation, charisma, influence, political correctness, beauty, ego, and manifest destiny. Leadership attributes are capitalized upon to unify significant bodies of individuals into a greater whole, accomplish significantly large goals and objectives, win momentous wars and battles, and lead people through extraordinary hardships and difficulties. Leaders also inspire organizations to develop innovatively new products and services, grow inordinately large, amass significantly large amounts of capital and human resources, and garner previously unprecedented revenues, profits, markets, and customers. When we think of great leaders in the high-technology sector, names that come to mind include Robert Oppenheimer, William Shockley, Gordon Moore, Bill Gates, Steve Jobs, Larry Page, Sergey Brin, Jeff Bezos, and Elon Musk.

Lean Think·ing (*lēn • thĭng'kĭng*) is a mindset, philosophy, and set of organizational management principles to successfully deliver innovatively new products and services of the highest possible quality to customers or markets with the fastest lead and cycle times. According to James Womack, the five lean principles are value, value stream, flow, pull, and perfection, thus lead and cycle time is optimized by minimizing Muda or waste (e.g., waiting, processing, motion, inventories, production, transportation, and defects). A variation of lean principles by the management consultancy LeanKit, includes optimize the whole, create knowledge, eliminate waste, build quality in, deliver fast, defer commitment, and respect people to reduce lead and cycle time of products and services. Another popular set of lean principles by Don Reinertsen to reduce lead and cycle time includes economic view, manage queues, exploit variability, reduce batch size, apply work in process (WIP) constraints, control flow, fast feedback, and decentralize control. The gist is to create demand-based end-to-end value streams, establish tight WIP limits, ruthlessly minimize waste, decimate batch size, rigorously measure performance, make sound economic decisions, and relentlessly improve.

Lean Lea·der·ship (*lēn • lē'dər-shĭp'*) is executives, directors, and managers who direct, manage, guide, shepherd, influence, motivate, or supervise lean thinking to quickly delight customers with innovative, high-quality products and services. That is, leadership, lean thinking, and lean leadership can't and shouldn't be ignored, delegated, refused, nor made optional, but rather lean thinking must be proactively instituted, planned, led, sponsored, expected, demanded, measured, and rewarded to succeed. People must be led, demand or pull-based value streams created, WIP limits established and enforced, workflows balanced and measured, batch sizes reduced, economic decisions made, waste removed, and organizational systems continuously optimized. Examples of reference models for such broad sweeping lean thinking organizational reforms for the high technology industry include the Kanban Maturity Model (KMM), Scaled Agile Framework (SAFe), Scrumban, Development Operations (DevOps), etc. So, what can or should lean leaders do (i.e., create lean policies, develop lean strategies, establish lean value streams, select lean reference models, provide lean thinking education, promote lean practices, reward lean behaviors, and lead lean activities)?

1. Ser·vant • Lea·der·ship (*sûr'vənt • lē'dər-shĭp'*) Guide, shepherd, direct, influence, inspire; To show the path forward

✓ **Recognized lean thinker**
✓ **Promotes lean principles**
✓ **Builds a lean organization**

It goes without saying that servant leadership is one of the top attributes of lean leadership in the early 21st century. What this means is that today's leaders should be focused on the well-being, health, and growth of people other than themselves, along with their teams, projects, programs, portfolios, departments, organizations, and enterprises. Much of this involves merely their presence most of the time, because it's very difficult to understand the state of a situation if one is absent and much easier to determine its health if one is present. Contrary to instinct, the best thing to do is empathetically observe, listen, and learn from interactions with individuals, teams, and organizations. In other words, resist the temptation to speak, give instruction, education, or give direction. Allow the teams to solve their own problems rather than solving their problems for them. Oftentimes, situations are due to lack of appropriate resources, so by listening, one can gauge whether the correct response is to provide more resources. However, oftentimes, just your presence, empathy, and sympathetic ear will go a long way towards showing you care. Being present at key events such as annual or quarterly planning, strategic and even tactical planning events, and the occasional working meeting, casual office event, or even hallway conversation will go a long way. People will engage you openly and honestly in a casual, off-the-record conversations, unload their frustrations and viewpoints, communicate essential information, and help you identify a constructive course of action in which to help teams unleash greater efficiency, effectiveness, and outcomes. This is quite a bit to ask of today's part-time, teleworking, jet-setting, multi-tasking, and highly paid organizational leader who spends most of their time at a remote headquarters building brownnosing with other executives. However, without your visible presence, organizational participants will assume you simply do not care, lean thinking is unimportant, and failure is okay.

RESULT: *Lean organizational change institutionalizes much faster*

2. Con·ver·sa·tion·al·ly • Rich (*kŏn'vər-sā'shən'ə-lē • rĭch*) Chat, discuss, exchange, dialogue; To exchange thoughts, feelings

✓ **Daily F2F communications**
✓ **Mostly casual and informal**
✓ **Unstructured conversation**

Highly interrelated to servant leadership is the essentiality of frequent, rich high-context conversations at all levels of the

enterprise, organization, project, and team. It's already been well established that cooperation, teamwork, collaboration, and interaction between customers and developers is absolutely essential to new product and service development success. Unfortunately, this often takes the form of endless, multi-hour-long Skype, WebEx, and face-to-face meetings for quarterly, program, iteration, and even daily planning events, meetings, and collaboration sessions. Then, there are the daily standups, mid-point checkups, demos, retrospectives, and other essential working sessions to discuss unplanned, out-of-scope emerging requirements and customer requests, or clarify misunderstandings arising from the main meetings. Pile on top of that, dozens of new meetings and ceremonies for business development, marketing functions, and corporate social responsibility, as well as the ever-present customer committees, working groups, and special events. However, we're not done yet, now add dozens of more ceremonies for the latest portfolio and program scaling governance frameworks, and people will be in meetings from sunup until sun down, often times without any benefit or effect. But, wait, there's more, with international teams, one must now meet late in the evening or in the wee hours the morning, or, participate in weeklong 24x7 system release management events to field large batches of poorly tested code. However, with everyone in meetings, when exactly are these conversations supposed to occur? Add to that, the absolutely necessity to do more listening than speaking during infrequent conversations. Unfortunately, having meetings 24 hours a day is a poor substitute for a short, impromptu hallway or watercooler conversation between two individuals to identify the root cause of an organizational crisis and the best course of action to mitigate the effects of an international incident.

RESULT: *Lean just-in-time exchange of up-to-date information/data*

3. High·ly • Col·lab·o·ra·tive (*hī-lē • kə-lăb'ə-rə-tĭv*) Cooperative, synergistic, together; To create a new idea together

✓ **Extremely small teams**
✓ **Work in collaborative pairs**
✓ **Temporary as-needed basis**

Of course, the ultimate goal of rich conversations is to use high degrees of collaboration to carefully listen to customer or market needs and then work together to create an innovative solution as quickly as possible. Often times, big things come in small packages and two people conversing and collaborating with one another can quickly identify a critical market need, a solution to that need, and the best course of action to fulfill that need in the near-term so that the individuals can move on to more enjoyable activities without an extended contract, project plan, or teaming agreement. Two people informally conversing and collaborating with one another can literally move mountains at the speed of light. One person can call, text, or email another person, often a total stranger half way around the world, pose a problem and possible solution, and the recipient can weigh in with a quick assessment, corrected course of action, and informal commitment to help solve the problem in the near term if conditions are agreeable. Once again, no extended contract is necessary up-front, a project plan and detailed integrated master schedule is not necessary apart from some broad deadlines, and, there doesn't even have to be a large team or dozens of daily ceremonies nor meetings to get the job done. In fact, the teams can agree to work synchronously if they're collocated by grabbing the nearest conference room for a few minutes or hours, or, the pair can work asynchronously, each constructing their part of the solution and then merging the parts later. With Skype and WebEx, yes, it is even possible for some synchronous brainstorming if necessary, but, asynchronous communication such as texts, Skypes, and Slack messages will often suffice. Once again, small methodologies with four or five mandatory ceremonies and daily standup meetings are often not necessary for truly creative collaboration and successful outcomes, nor are large reference frameworks that will saddle teams with dozens of more ceremonies on top of these.

RESULT: *Lean innovations developed and delivered extremely fast*

4. Vis·u·al·ly • In·ten·sive (*'vĭzh'oo-ə-lē • ĭn 'tĕn'sĭv*) Draw, paint, picture, model, illustrate, elucidate; To communicate with images

✓ **Simple, informal visuals**
✓ **More pictures than words**
✓ **Low cost, easy to maintain**

It is often said that a (simple) picture is worth a thousand words, and that old adage couldn't be truer today than it was when that phrase was coined by Fred R. Barnard in the 1920s. Oftentimes, a simple informal (back of the napkin) sketch, idea, (game) plan, or agreement will do. How about a daily (prioritized) to-do list, action plan, or shopping list? When two people are informally conversing and collaborating, a simple action plan will suffice (e.g., "I'll go right, and you go left!"). Architects will often create an artist's rendering of a multi-billion-dollar project because that's all they need secure legal, long-term customer commitment instead of a detailed project plan, list of requirements, or foot-high stack of blueprints. The human brain is wired for quick, near-real-time audio and video visual cues that result in instant calls to action, commitment, effort, and subsequent outcomes. Again, simple design sketches, bulleted lists, impassioned verbal pleas, or even models, prototypes, and written examples will suffice. Unfortunately, people mistake "simple" visual information for elaborate enterprise architectures, project charters, project plans, integrated master schedules, work breakdown structures, Gantt charts, machine readable project network diagrams, business requirements documents, system models rendered in formal architecture description languages, encyclopedic definitions of ready and definitions of done. Complex computers conceived by soldering two wires together to determine if data flowed between them have turned around failing corporations and created multi-billion-dollar cottage industries! Again, all two people require to get the job done is a simple sketch, outline, picture, diagram, schema, action plan, or concrete example. Even verbal clarification helps through a quick phone conversation, Skype or WebEx meeting, informal conversation, hallway chat, watercooler conversation, beer, or glass of wine at a happy hour! The key words here are SIMPLE, actionable, agreeable, enjoyable, and rewarding.

RESULT: *Lean information exchanged holistically and completely*

5. So·cial • At·mos·phere (*sō'shəl • 'ăt'məs-fîr'*) Friendly, congenial, kind, amicable, intimate, neighborly; [To interact in a positive way](#)

✓ **A congenial workplace**
✓ **Make it informal, intimate**
✓ **Conducive to cooperation**

A key element of lean leadership is to foster, create, and cultivate a highly social, informal, and collegial atmosphere where collaboration, communication, relationships, commitment, trust, and innovation can form, bloom, and thrive. This is hard to do with today's part-time jet setting meeting-intensive culture with rigid high-power distance hierarchies, and highly competitive managers backstabbing one another to climb corporate ladders as quickly as possible with expert, assassin-like ease! So, the key is to ease back on the formality, meetings, hierarchy, plans, documentation, requirements, elaborate designs, selfish-individualism, and relentless schedules. Today's leaders need to build in some margin, time, and activities in which to communicate and collaborate. Small collocated teams with open office workspaces can help a little where conversations can flow freely, rotating teams and assignments into pairs and small teams can help, and, of course, openly sharing project information, technical solutions, and other ideas across teams can help too. Encourage, teach, and reward people to talk and socialize with one another, because social skills and emotional intelligence do not come naturally to people. In fact, hundreds of millions of years of evolutionary biology illustrate that species prevent, discourage, and attack social interaction between unlike species and will also prevent socialization within their species too. It's safer, easier, and less threatening to develop one trusted confidant rather than to socialize with the whole group. Once again, social skills are not instinctual and must be taught, encouraged, and opportunities for socialization must be proactively created. Today's lean leaders must build in time, opportunity, and margin for social interaction, communication, collaboration, and relationship building in order to successfully create innovatively new product and services. No one person has all of the answers, so social skills are essential for information to freely flow between all of your expensive personnel.

RESULT: *Lean performance optimizes, balances, and stabilizes*

6. Em·pow·er·ment • O·ri·ent·ed (*ĕm-pou'ər-mənt • ôr'ē-ənt'ĭd*) Delegate, permit, endow, entitle, authorize; [To grant equal decision rights](#)

✓ **Delegate power, authority**
✓ **Instill employee ownership**
✓ **Bottom up decision making**

Empowerment of all people in the organization and teams with autonomy, decision-making rights, time-management, and the methods of achieving outcomes is a critical element to successfully creating innovatively new products and services as well as organizational success itself. Gone are the days when slaves are merely kidnapped from foreign nations, shackled to your plantation, and ruthless tormented to do preselected tasks for the landowners. This form of exacting productivity from individuals never has nor will it ever be superior to granting individual freedom and decision-making rights. Instead, bring individuals together at regular intervals, teach them how to form organizational goals and objectives, empower them to identify self-selected goals, and then further empower them to pursue and achieve those goals by whatever legal, moral, and ethical means necessary. This is counterintuitive to the traditional thinking where executives form corporate goals and objectives, directors design portfolios, managers create plans, and supervisors tell people exactly what to do and when to do it. Instead, develop your personnel, train and educate them in the tools and principles of new product development, allow them to interact with your customers and market representatives, empower them to identify customer needs and create innovative solutions using innovative methods, enjoy the fruit of their creative energy, and share the economic and status resulting from their successes. Properly trained, educated, aligned, and empowered people will achieve outcomes hundreds and thousands of times greater than what is possible when told exactly what do and how to do it like four-year-old children. Conversely, leaders can select outdated 50-year-old goals and objectives, force people to pursue them, and punish them from deviating from your plans or reward people for creating expensive obsolete products and services that no one needs. It's sad to say, that we still haven't learned the lessons from the last century.

RESULT: *Lean performance is enabled to reach peak speed/quality*

7. Fo·cused • Sin·gle • Task·ing (*fō'kəst • sĭng'gəl • tăsk'ĭng*) Aim, point, direct, zero-in, undivided, concentrate on; [To concentrate on a single task](#)

✓ **Do one small task at a time**
✓ **Prepare, start, and finish**
✓ **Minimize interruptions**

Today's leaders need to sharply focus on the science of lean thinking beginning with focused single tasking, which differentiates it from fruitless traditional principles based on high-tech slavery, full utilization, overallocation, and disempowerment. Lean leaders should allow teams enough time to focus on the total success of one small requirement, task, activity, or outcome at a time rather than blitzing, blinding, confusing, and tormenting people with thousands of outdated customer needs fabricated by business analysts into mountainous business requirements documents. Part of this, of course, is to build in extra time and margin to train and orient people to solve the problem, informally communicate and collaborate with customers and teammates about possible solutions, give people enough time to actually solve the problem, and, of course, build in a little extra time for creative endeavors and pursuits as well. With this model, customers can get exactly what they want when they need it, the result will be valuable and of the highest quality, and the team will actually enjoy producing it and have time for personal growth and fulfillment as well. This

obviously means that teams of full-time business analysts collecting thousands of requirements into voluminous business requirements documents is a bit overkill, forcing your teams to implement these encyclopedias of business requirements on a shoe string budget and timeline at the threat of termination is a bad idea from the 19th century slave era, and nothing actually gets done under this old antiquated model except to collect payment from dissatisfied customers for incomplete work. It's a great business model if you can get away with it, buyers and suppliers are willing to play this deceptive game, and project managers can keep a straight face with customers and teams without accomplishing anything of value. Conversely, allow teams to deliver one requirement at a time with enough time to get it done and lean leaders will immediately enjoy the fruits of their success.

RESULT: *Lean speed, quality, cycle time, performance improve*

8. Light·ened • Work·load (*līt'ənd • wûrk'lōd'*) Ease, decrease, lessen, remove, relieve, alleviate; [To decrease size of a large task]

✓ **Decrease task sizes**
✓ **Build in excess capacity**
✓ **Allow time to be productive**

Today's leaders need to continue delving into the science of lean thinking with lightening workloads by building in extra margins of time, reducing the amount of work, and slowing the pace of new product and service development activities. Once again, to do so is to substitute traditional thinking principles of multitasking, full utilization, and overallocation in order to extract every penny of value from a small number of underpaid worker bees to create value for a large volume of overpaid executives, directors, and middle managers. Less is more in the science of lean thinking and conversely more is less. That is, when you lighten the workload, more gets done sooner, and when you increase the workload less gets done at all with increasing frequency until all progress stops. Lightening workloads gives workers adequate time to converse, collaborate, socialize, and brainstorm problems and solutions with customers and fellow teammates. Furthermore, it allows for cross pollination, knowledge sharing, and design of innovative solutions to complex problems. Taking away buffers of extra time by the traditional principle of full utilization reduces any opportunity to meet with customers, cross train, brainstorm innovative designs, and create high quality solutions. Traditional thinking-oriented multitasking creates such a large overhead of context switching that it reduces the amount of time to do any constructive problem solving and solutioning to nearly zero for any of the myriad of customer needs from business requirements documents manifesting themselves as tasks on a schedule. When workers have enough time to plan, think, socialize, interact, collaborate, share knowledge, and create thoughtful solutions, then magic happens, high-quality innovatively new products and services of immense business value emerge, and customers are delighted not just satisfied. Furthermore, workers themselves feel empowered, employees develop a sense of deep long-lasting loyalty, and feel an immense sense of pride of ownership.

RESULT: *Lean throughput, lead time, cycle time, quality improve*

9. Bal·anced • Work·flow (*băl'ənst • wûrk'flō'*) Level, match, align, smooth, equalize, harmonize; [To harmonize opposing forces]

✓ **Match demand to capacity**
✓ **Pull work through system**
✓ **Start work you can finish**

Today's leaders can really take advantage of lean thinking principles such as balanced workflow to match the capacity for performing work to the demand for the work. That is, work should be pulled through the value stream based on customer demand for the work. When the customer or market expresses a need, the workforce should begin the work if they have capacity to perform it, they should focus on fulfilling the customer need without starting on another requirement, and they should deliver the solution to the customer when it is complete. Therefore, one request or customer need should result in one demand upon the worker's capacity, the workers should collaborate to perform the work together as a team and the solution should be delivered to the customer or market in the shortest possible lead and cycle time. Once again, work should not be pushed into the system nor onto the teams. Armies of business analysts should not be allowed to fabricate mountains of business requirements documents to be pushed onto teams in the form of statements of work, system specifications, schedules, work breakdown structures, tasks, work packages, and individual assignments. Even after traditional thinkers push too much work on teams and individuals in the form of wasteful work-in-process real end-users neither requested nor need, traditional project managers continue to push new work on teams and individuals on a daily basis and even assign teams and workers to multiple projects, special initiatives, and tasks. All of this non-sense leads to an unbalanced workflow where real, genuine end users, customers, and markets have neither expressed a direct need, nor do the teams and individuals have capacity to fulfill a real need when it emerges. Balanced workflow is the Shangri La of lean thinking, and although it could be discussed last not first after other fundamental lean principles, its good to talk about it early for a number of reasons in order to establish a foundation or business case for other basic lean principles.

RESULT: *Lean wait time, bottlenecks, queues and delays reduced*

10. Prod·uct • O·ri·en·ta·tion (*prŏd'əkt • ôr'ē-ĕn-tā'shən*) Wares, goods, yield, output, release, merchandise; [To deliver a valuable request]

✓ **Establish value streams**
✓ **Deliver small products fast**
✓ **Create product ecosystems**

Today's leaders must shift from project to product-oriented value streams to achieve benefits of lean thinking such as reductions in lead and cycle times. Leaders must create long-lived pull or demand-based lean value streams versus chartering temporary

projects with fixed scopes, budgets, and timelines to attempt complex new products and services. There is a myriad of challenges associated with projects such as unmanageable risk, uncertainty, ambiguity, complexity, cost, length, and 70% to 90% failure rates. The larger and more complex a project is, the greater the probability one doesn't really know the true customer or market needs, business analysts will fabricate volumes of business requirements, and they cost more and take a long time. As Moore's Law states, technology morphs every 18 months or less, so long projects risk rapid technological obsolescence, a dearth of skilled labor, and the likelihood of missing market windows or opportunities, decimating the business case for projects. With lean value streams, long-lived teams are formed, smaller experimental minimal viable products (MVPs) are created, often in the form of microservices, new product and service ideas are tested and validated in rapid cycles, and true customer or market needs are quickly and cost-effectively uncovered without breaking the bank. New market probes are created in as little as two weeks using Design Sprints, 90 days using experimental MVPs, or in as little as minutes and hours using DevOps principles. Two-pizza teams can be quickly and cost effectively formed and spun up, skills and personalities can be quickly identified and matched, ideas can be quickly solutioned and fashioned, and customer and market feedback and perceptions can be quickly measured. With valid data in hand, economic decision-making can be quickly exploited, and this cycle can be rinsed and repeated many times at the budget of a temporary traditional project until customers and markets are completely delighted and satisfied.

RESULT: *Lean value creation achieved via rapid product feedback*

11. Small • Ex·per·i·ments (*smôl • ĭk-spĕr'ə-məntz*) Test, trial, probe, model, sample, prototype; To gather rapid data from a test

✓ **Form business hypotheses**
✓ **Develop fast, low-cost tests**
✓ **Gather feedback and repeat**

Lean leaders must fundamentally change their mindset or philosophy from thinking in terms of decade long multi-billion new product and service development cycles to small "hypothesis-testing-based" experiments to tease out valid customer or market needs. That is, fund a series of numerous short-term business experiments, prototypes, market probes, and product and service mockups, gather feedback from customers, and refine these concepts until tacit customer needs are sufficiently uncovered. With these valid data in-hand, innovatively new tightly scoped products and services can be quickly and cost-effectively fielded that are hardened, secured, and delivered with amazingly short lead and cycle times. Of course, this is a fundamental shift in the thinking and reward systems of traditional organizations, firms, leaders, managers, and even employees. Large organizations with deep budgets are accustomed to funding decade long billion-dollar projects, leaders are rewarded for managing large volumes of resources, and large projects have a temporary stabilizing effect on organizations and the workforce itself. People have time to breathe, get hired, work, gather paychecks, buy houses, go to school, have children, take vacations, get bonuses, get promoted, and pretty much live long-term stable lifestyles. However, the debilitating effects of long-term projects outweigh and perceived benefits of long-term, billion-dollar projects. For one, they are expensive to undertake except for the largest organizations, small startups have to spend their time and energy accumulating the resources for large-scope projects from venture capitalists, and, of course uncertainty, risk, complexity, cost, quality, customer satisfaction, and market windows or opportunities quickly evaporate. Not to mention technology obsolescence and skill shortages often take a large bite out of high technology firms. Budgets are soon exhausted, everyone is pressured to rush out a poor solution, and any hope of delighting customers and markets is gone.

RESULT: *Lean throughput, value, and performance achieved fast*

12. Ex·treme·ly • Small • Batch·es (*ik ˈstrēm'lē • smôl • băch'əs*) Group, set, lot, pack, bunch, collection, aggregate; To order a small size of jobs

✓ **Decrease batch sizes**
✓ **Shorten delivery times**
✓ **Plan for fast turnaround**

Lean leaders must also undergo another fundamental change in mindset or philosophy from thinking in terms of large initiatives, portfolios, programs, and projects to extremely small batches in terms of size, scope, complexity, size, cost, risk, and duration. That is, broaden their minds to think of rapidly creating and fielding innovatively new products and services with extremely small batch sizes instead of creating and managing large and ambitious decade-long multi-billion-dollar programs and projects. The last century instilled a false sense of security in the value of long and expensive programs and projects, as well as the myth that traditional portfolio, program, and project reference models could be applied to successfully manage immense complexity. As the old adage goes, "the bigger they are, the harder they fall!," and the data against large and complex corporate initiatives is overwhelming. More than 70% of corporate initiatives do not succeed nor do they yield their promised benefits. These include mergers and acquisitions, large scale change and transformation initiatives, complex decade long systems of systems, and of course, traditional fixed-scope projects based on voluminous business requirements documents with infinite and unmeasurable complexity. Conversely, initiatives based on principles of extremely small batches are inexpensive, fast, can be quickly staffed, have lower risk, complexity, and uncertainty, and are deeply satisfying to everyone involved including executives, managers, workers, and, especially customers, end-users, and markets. Extremely small batches can be requested quickly and frequently by demanding markets and customers, funded and resourced quickly, solutioned and delivered easily, and flow through pull or demand-based value streams friction-free. All of this combines to decimate lead and cycle times delighting everyone involved including shareholders and business owners, executives and directors, project managers, customers, and even employees too.

RESULT: *Lean lead, cycle time, and feedback cycles decreased*

13. One·piece • Work·flow (*wŭn′pēs • wûrk′flō′*) Single, only, isolated, solitary, discrete, individual; [To order one element at a time](#)

✓ **One requirement at a time**
✓ **Make requirements small**
✓ **Deploy requirement fast**

A major lean thinking principle lean leaders should focus upon is the notion of one-piece workflow, which is highly complementary to many lean principles discussed so far. That is, people at all levels of the lean value stream including customers, executives, managers, developers, testers, and operational personnel should start solutioning one salient customer need at a time. People should focus on one customer need at a time almost exclusively and don't begin solutioning another customer need or task until it is successfully completed. Furthermore, people at all levels of the value stream should collaborate together to solution that customer need as a small multi-disciplinary cross functional team instead of a linear pipeline of individual handoffs. In the best case, the customer need, piece, or work item type is small, tightly scoped, inexpensive, of low risk and complexity, and can be solutioned quickly with fast lead and cycle times. Leaders at all levels of the organization should dispense with the myth that all solutioning has successful outcomes. The purpose of lean principles such as one-piece workflow is to put a solution in front of customers as quickly as possible to collect, measure, and evaluate customer and market feedback. That data and information may be contrary to expectations (i.e., it may be determined that the customer didn't like it and returns it, or the delivery team may decide it is not in the best interest of the organization to continue delivering the solution). Perhaps the solution was too expensive, complex, misaligned with organizational goals and objectives, nor is compatible with existing value streams. Some supply chains may be intermediated or disintermediated, or perhaps new value streams may be created to accommodate incompatible solutions. In any case, by focusing on one-piece workflow, organizations can get to yes, no, or maybe quickly and cost-effectively, valid economic decisions can be made, and teams can move on to solutioning the next value adding product or service.

RESULT: *Lean performance, feedback, and value achieved quickly*

14. Min·i·mal·is·tic • De·sign (*mĭn′ə-mə-lĭs′tĭk • dĭ-zīn′*) Easy, small, simple, elementary, uncomplicated; [To create a very simple solution](#)

✓ **Form very simple designs**
✓ **Independent as possible**
✓ **Create a single function**

Today's leaders should promote lean principles of minimalistic design that are complementary to focused single tasking, balanced workflow, product orientation, small experiments, extremely small batches, one-piece workflow, and softer principles. If customer needs are to be delivered with the shortest lead and cycle times, then the scope of solutions should be kept as small, narrow, simple, inexpensive, near-term, and low-risk as possible, often using one-or-two-week early design sprints. One or two new product or service characteristics of high business or market value should be developed based on small collaborative executive and senior decision-making teams, minimalistic designs quickly formed, and feedback gathered fast. Traditional expensive, multi-decade-long, multi-billion-dollar enterprise, system of system, and complex solution architectures are formed by fabricating characteristics for every conceivable customer need, resulting in excessive waste or WIP. Architecture and design blueprints are necessary for success, but they should focus on the solution to meeting a high-priority customer need at hand, especially in the early stages of an experimental MVP. Once a solution is quickly formed, then architectures and designs can be scaled up to small families or ecosystems of interrelated products and services. However, any expensive architectural or design foundation must be justified based on profitable, customer satisfying solutions. There's no sense in laying a foundation for a collection of new products and services that customers and markets don't want or need. Technology evolves very quickly, so laying down an expensive, long-term architectural runway leads to lost resources in a rapidly obsolete foundation. There's no sense in laying down a capital-intensive architecture for a foundation of products and services that will be obsolete in 30, 60, or 90-day cycles. Minimalistic designs for innovative products and services must yield immediate market benefits within dynamically changing market windows.

RESULT: *Lean lead times, cycle times, and delivery speeds increase*

15. E·mer·gent • Ar·chi·tec·ture (*ĭ-mûr′jənt • är′kĭ-tĕk′chər*) Grow, form, rise, evolve, unfold, develop, mature; [To gradually evolve a solution](#)

✓ **Gradually create designs**
✓ **Grow and evolve solutions**
✓ **Adapt to unplanned change**

A lean principle that leaders must consider is emergent architecture that complements focused single tasking, balanced workflow, product orientation, small experiments, extremely small batches, one-piece workflow, minimalistic design, and even soft principles. It complements classical lean principles like just-in-time production, whereas only just-enough architecture is created to satisfy the solutioning of one customer need at a time. It's faster and requires less cost, risk, resources, time, complexity, and resources. There's no need to create an expensive long-term architecture, since the goal of a solutioning one customer need at time is to gather feedback, uncover tacit customer needs, and determine whether customers are satisfied at all. A major goal is to determine the viability, profitability, or organizational fit for purpose. For instance, does the solution satisfy business goals and objectives, is it aligned with value streams, and does it have long-term value? In other words, let the longer-term architectural platform of an ecosystem emerge, evolve, aggregate, and amalgamate to satisfy a smaller number of just-in-time customer needs. Since one small architecture is inexpensive, the cost, expense, and effort of adapting, expanding, replacing, or abandoning an early design is

negligible. This is contrary to traditional architectural principles that strive to create a 500-room hotel floorplan, when a $50 motel room will suffice if you are driving at 1:00 am and are simply tired. Or, consider taking a taxi if you need to go someplace, rather than designing a 100-year aircraft system of systems. If a long-term design is justified, then only spend just-enough for a slightly larger design, but not a monolithic one. If you outgrow the usefulness of taxis, consider buying a used car vs. a Ferrari. Large, long-term bureaucracies fall victim to the myth of investing in expensive architectures with little value just because they have the resources to do so. Too much money is a cancer in large public and private bureaucracies leading to a false sense of security.

RESULT: *Lean customer value reached very quickly and completely*

16. Mod·u·la·rized • Mi·cro·ser·vic·es (*mŏj'ə-lə-rīzd' • mī'krō-sûr'vĭs'əs*) Unit, chunk, block, interchangeable component; To make small independent units

- ✓ **Create small services**
- ✓ **Functionally independent**
- ✓ **Amalgamate to ecosystems**

Leaders of high technology organizations should also shift their focus and attention to emerging lean principles such as creating innovative new products and services based on modularized microservices vs. monolithic projects, products, and architectures. That is, rather than investing in multi-decade, multi-billion-dollar products, solutions, and architectures, leaders should focus on creating a small ecosystem of independent software modules like portable apps, web services, or even embedded components. Good examples include smartphone apps, wearable mobile apps, end-user Internet or web applications, cloud services, medical or healthcare apps, financial or investment services, entertainment or media apps, travel apps, or even language or cultural apps. Think of useful apps such as Google search, Google mail, Google maps, a texting app, a weather service widget, Skype app, international language translator, billing app, Amazon, eBay, mobile games and entertainment, or any myriad of other useful apps. Even traditional products and services lend themselves to microservices such as spacecraft, aircraft, automobiles, healthcare services, medical devices, communication devices, software radios, home monitoring, facility management, law enforcement, etc. The goal is not to create complex, expensive, and high-risk multi-decade-long, multi-billion-dollar capital-intensive product and service systems of system architectures, but rather the smallest, self-contained, and most valuable software services possible. Lean principles such as focused single tasking, balanced workflow, product orientation, small experiments, extremely small batches, one-piece workflow, minimalistic design, and soft principles can quickly yield innovative products and services with modularized microservices. This has implications for traditional, capital-intensive industries such as brick-and-mortar enterprises, manufacturers of inflexible hardware, and other consumer electronic designers that fall victim to rapid technological obsolescence.

RESULT: *Lean value is achieved fast, efficiently, and effectively*

17. In·tense • Dev·Ops • Au·to·ma·tion (*ĭn-tĕns' • dĕv'ŏps • ô'tə-mā'shən*) Early, automated, iterative, fast, test, integrate, deploy; To automate test and deployment

- ✓ **Automate version control**
- ✓ **Automate end-to-end tests**
- ✓ **Create automated pipelines**

Intense DevOps automation and modularized microservices go hand-in-hand, and demand the immediate attention of today's leaders, especially those of high-technology organizations, which enables the fastest possible throughput through value streams. Every step of the value stream should be automated, share common platforms, and automate as many traditional manual activities as possible. Customer needs should be logged in the DevOps tool chain, epics, features, and user stories formed, acceptance criteria established, code created, version controlled, and tested, and operational systems evaluated, validated, and accredited. Code should flow from the fingertips of small, two-pizza teams directly to end-users and customers, everyone should see test results, users should evaluate and use the results, customer feedback should be collected and evaluated, and the cycle repeated. The DevOps cycle should take seconds and minutes in the ideal case and best-in-class organizations, firms, and enterprises often deploy 50 to 1,000 microservices per day in this fashion, while traditional organizations require months, years, and decades. It's not just about deploying untested code quickly, but running thousands and sometimes millions of tests, including development, integration, system, acceptance, performance, security, and usability tests. So, end-users are not receiving half-baked, untested code, but fully validated microservices-based solutions. Humans are not perfect, and failures are automatically detected, microservices terminated before they can create damaging results, and the system baseline automatically reverted to a known state. Microservices are often engineered within containers, so any damaging effects of software failures are isolated to the microservice itself, without spillage or ill-effects to the greater microservice ecosystem and the ecosystem itself is engineered to be resilient to healthy operation with or without the presence of any single microservice, like a smartphone without any one app.

RESULT: *Lean balance of work flows, demand and value achieved*

18. Fre·quent • Small • De·ploy·ments (*frē'kwənt • smôl • dĭ-ploi'məntz*) Send, ship, deliver, launch, release, install, distribute; To quickly deploy small services

- ✓ **Create small microservices**
- ✓ **Automatic test and certify**
- ✓ **Fast automatic deploys**

Lean leaders must also demand frequent small deployments, which embodies so many modern lean principles characteristics of

today's high technology marketplace. Of course, the underlying goal is to accelerate lead and cycle times from concept through production, so that organizations can gather customer feedback, tease out tacit knowledge, and optimize business value at the speed of light. However, it also epitomizes principles of focused single tasking, balanced workflow, product orientation, small experiments, extremely small batches, one-piece workflow, minimalistic design, emergent architecture, and modularized microservices. Therefore, a new measure of business success is not just revenues, profit, and market share, but number of deployments per week, hour, and day. This is a proxy measure for how efficient the lean value stream is, how short lead and cycle times are, how fast customer deliveries are made, how quickly customer and market feedback are collected, and, of course, how fast true market needs are being determined. Like the other lean principles, it allows organizations to optimize value streams, product development flow, quality, automation, process improvement, convergence, alignment, and then classical measures like revenues, profits, and market share. It's also a measure of lean performance, that is whether the value stream is waste, WIP, and bottleneck free. If innovatively new products and services are flowing from concept to production hundreds of times per week, day, and hour, then there is little non-value adding work in the pipeline. Of course, real process improvement must be taking place. For instance, it doesn't really matter whether a mobile app is updated hundreds of times per week unless some measure of business value is being achieved. These can be non-functional characteristics like quality, reliability, availability, speed, efficiency, usability, performance, resiliency, or integration to other features in the value stream that provide superior user experience.

RESULT: *Lean workflow, effectiveness, efficiency, value, & feedback*

19. **Fast** • **End·to·End** • **Cy·cle·times** (*făst • ĕnd-tōo-ĕnd • sī'kəl-tīmz*) Effort, hours, duration, schedule, throughput, interval; [To accelerate end-to-end delivery](#)

✓ **Map end-to-end value stream**
✓ **Eliminate low-value activity**
✓ **Automate manual process**

A lean thinking principle that leaders have been asked to prioritize for three decades is fast end-to-end cycle times. That is, if your lean workflow system is measured, balanced, and optimized, then innovatively new, high-quality, and deeply satisfying products and services flow from concept to production in days, minutes, and seconds. In today's global online marketplace, demanding customers require the highest quality, value-adding products and services at the most competitive prices. Oftentimes, fast cycle end-to-end cycle times are translated into the shortest possible lead times, that is, the wait time from the moment a service is desired to the time a service has been ordered, but not necessarily fulfilled. For instance, how fast does a waiter seat you and take your order, how long does it take for a doctor to see you in a routine or emergency visit, or how fast you can close a deal on a new car. Historically, wait times were extremely long, especially in the healthcare field or new car buying experience. However, in today's lean thinking-based marketplace, wait times have been decimated to minutes. One can visit an Amazon website, compose a large and complex order and check out in a matter of minutes, one can now order a new car in a matter of minutes, or hospital emergency rooms now boast doctors will begin treating your malady in two to three minutes as well. For more serious cases, cancer patients can walk into clinics without an appointment, see all specialists in a matter of minutes, and exit with a get-well plan in less than a day. Compare this to traditional cancer patient experiences that once took months and even years for the same level of service. The stress of waiting has a negative effect on health, and vice versa, short wait times improve mental and physical health. By decimating wait and delivery times, customers, no matter what their societal status, can receive the highest quality, value adding, and innovatively new products and services at the most competitive market prices which is deeply satisfying.

RESULT: *Lean workflow fast, efficient, value adding, & inexpensive*

20. **Shift·left** • **In·no·va·tion** (*shĭft'lĕft • ĭn'ə-vā'shən*) Invent, create, new, fresh, original, novelty, futuristic; [To create new original solution](#)

✓ **More up-front designers**
✓ **Fast small experimentation**
✓ **Automated backend deploy**

The ultimate lean thinking goal of today's leaders is to focus on shift-left innovation, which is simultaneously intuitive and counterintuitive, and challenging to balance, optimize, or get correctly in the global high-tech industry. Leaders need to design a lean organizational system that places more investment in customer-facing innovators of new products services instead of administrative or operational personnel. If you implement lean principles such as focused single tasking, balanced workflow, product orientation, small experiments, extremely small batches, one-piece workflow, minimalistic design, emergent architecture, modularized microservices, and fast end-to-end cycle times, then a small team of innovators can simply drive the organization like a sports car. Innovators should interface to customers, gather their needs, rapidly create and deliver solutions, measure feedback, and rinse and repeat at the speed of light without a monolithic workforce doing the manual labor behind the scenes. Conversely, you can hire an army of middle managers to tell a small team of low-priced unskilled programmers what to do, but this isn't exactly the same thing. Much of this is having a fully automated, optimized, and high performing DevOps pipeline where new ideas can rapidly flow back and forth between innovators and consumers. During the 1990s, quality became such a driving focus that global high-tech corporations hired tens of thousands of low-priced manual software testers. This increased quality a little bit, but it also increased costs and decreased cycle times, while innovation suffered greatly. Smaller, more innovative firms such as Yahoo, Netscape, Amazon, Google, and Tesla leapfrogged the competition weighed down with billions of dollars in capital infrastructures and tens of thousands of low-priced quality assurance testers like Microsoft. World-class DevOps firms now spend 80% of their resources on small teams of innovators and less than 20% of their resources on optimizing fully automated DevOps pipelines.

21. Cus·tom·er • Meas·ure·ment (*kŭs'tə-mər • mĕzh'ər-mənt*) Count, quantify, qualify, appraise, assess, evaluate; [To quickly assess customer value]

✓ **Quickly market prototypes**
✓ **Assess customer reaction**
✓ **Optimize customer value**

Customer measurement is a major focus of today's lean leaders, because you simply cannot manage what you don't measure, and measuring performance of the lean value stream is paramount to organizational success. The lean leader's goal should shift from just measuring number and size of mergers and acquisitions, capital footprint, sheer number of employees, revenues, profits, market share, and shareholder value to customer views of new products and services. Leaders must delight customers with the shortest possible lead, cycle, and wait times, quickly deliver high quality, value adding products and services, add characteristics that increase customer satisfaction, and remove unwanted features. Leaders must measure the performance of the internal lean organizational system such as morale and satisfaction of the workforce themselves, because employee satisfaction is a strong indicator of lean health. When all stakeholders are deeply satisfied, not just customers, but the internal workforce is deeply satisfied too, then leaders can say they are measuring the performance of the total value stream and achieving organizational success. Measurement is quantitative and automated, but qualitative measures are important too, as leaders must "go and see" and visit customers, stakeholders, and workers to experience for themselves whether the organizational system is properly functioning. Conversely, traditional leaders still use debilitating measures such as cost and schedule performance. The ultimate test of the organization's health is whether leaders would be happy performing any of the tasks in the organization, as lean leaders should "do unto others as you would have them do unto you!" What's good for the goose is good for the gander, and minimal hypocrisy is a key lean principle. Social justice is a key element of democracy, empowerment, equality, collaboration, egalitarianism, and deep satisfaction of all stakeholders within a well-balanced, well-oiled, and optimizing lean value stream.

RESULT: *Lean end-to-end enterprise value creation & optimization*

22. Re·lent·less • Im·prove·ment (*rĭ-lĕnt'lĭs • ĭm-proŏv'mənt*) Fix, enhance, amend, refine, polish, purify, perfect; [To make fast frequent correction]

✓ **Frequently retrospect**
✓ **Radical process redesign**
✓ **Quickly implement changes**

The single most important lean thinking tool today's leaders can apply is relentless improvement, which means to frequently retrospect on what's working well, what isn't, and what needs to work better! These are often synchronized with lean activities such as design sprints, planning, value stream mapping, solutioning and delivering, customer feedback, and other significant product and service activities. They should be done on a weekly, bi-weekly, monthly, quarterly, bi-annual, and annual basis for individuals, collaborative pairs, teams, development groups, value streams, lean coaches, middle and senior managers, and executives too. They may be run openly, or anonymous feedback may be collected to get direct feedback about improvement actions, and individuals and teams must be proactively taught how to constructively and professionally retrospect without getting personal. Relentless improvement is often overlooked because its significance is not fully understood, it is ignored because people are busy, or it is sidetracked because people are afraid of negative, critical, and career-limiting feedback. However, ignoring it, waiting too long to do it, or ignoring the results is detrimental to quickly creating innovative new products and services, and it should be done immediately after a significant delivery, even if a one-day event. People are afraid to openly render constructive feedback because it is perceived to be critical, they're afraid to question well-respected leaders, they openly attack disliked leaders and individuals, or they privately gossip about people and situations. Sometimes, it may be best to regularly meet with key stakeholders throughout an organization to gather qualitative feedback on team and organizational performance. Relentless improvement should not be overlooked to protect the status quo amidst organizational decline, which is often the case, nor overreact to special causes and fire the redheaded stepchild, which is also a common organizationally debilitating behavior.

RESULT: *Lean end-to-end efficiency, effectiveness & market value*

Summary

So, what exactly have we learned about 21st century organizational leadership teams that wish to apply lean thinking principles, take proactive roles in guiding lean initiatives and transformations, and help enable lean project teams by removing impediments? First of all, we've learned organizational leaders must proactively promote, establish, support, enact, and ensure lean thinking throughout their organizations with highly visible support, policies, strategies, resources, plans, involvement, and reinforcement. Second of all, we've learned lean leadership involves creating, implementing, operationalizing, and maintaining culture of applying lean thinking principles, such as identifying value, mapping value streams, creating flow, establishing pull, and seeking perfection. Third of all, we've learned there are more salient lean principles, such as taking an economic view, managing queues, exploiting variability, reducing batch sizes, applying WIP constraints, controlling flow, getting fast feedback, and decentralizing control. Fourthly, we've learned lean leaders must apply principles such as servant leadership, rich conversations, creative collaboration, intensive visualization, social atmospheres, empowerment orientation, focused single tasking, lightened workloads, balanced workflow, product orientation, small experiments, extremely small batches, one-piece workflow, and minimalistic designs. Finally, these also include, but are not limited to emergent architecture, modularized microservices, intense DevOps automation, frequent small deployments, fast end-to-end cycle times, shift-left innovation, customer measurement, and relentless improvement.

22 ATTRIBUTES OF LEAN LEADERS, EXECUTIVES, DIRECTORS, AND MANAGERS

- ✓ *Servant Leadership*
- ✓ *Extremely Small Batches*
- ✓ *Business Experimentation*
- ✓ *Simple Minimalistic Designs*
- ✓ *Emergent & Evolutionary Design*
- ✓ *Small, Highly Collaborative Teams*
- ✓ *Focused, Single-Tasking, Limited WIP*
- ✓ *Long-Lived Value Streams & Budgeting*
- ✓ *Rich, High-Context Informal Conversations*
- ✓ *End-to-End Fully Automated DevOps Pipelines*
- ✓ *Level Workflow by Matching Capacity to Demand*
- ✓ *One-Piece Workflow & Frequent Small Deployments*
- ✓ *Highly Modularized Design-Independent Microservices*
- ✓ *Excess Capacity for Fewer High-Value Adding Innovations*
- ✓ *Frequent Qualitative & Quantitative Customer Measurements*
- ✓ *Continuous Improvement, Adaptation to Change, Pivot & Move*
- ✓ *Radical End-to-End Value Stream Lead & Cycle Time Reductions*
- ✓ *Simple Visualization, Openness, and Transparent Communications*
- ✓ *Happy, Healthy, & Informal Social Relationships, Trust, & Attitudes*
- ✓ *Empowerment, Employee Ownership, & Frontline Bottoms-Up Decision-Making*
- ✓ *Shift-Left Thinking—More People Creating & Innovating than Testing & Validating*

The principles outlined in this treatise on lean leadership and lean thinking are intended for creating innovatively new, high quality, competitively priced, value adding, and customer delighting products and services with the shortest possible lead and cycle times. Although they are illustrative of firms creating fast, flexible, and highly automated information technology-intensive products and services, they are certainly not comprehensive, nor forward looking enough to include emerging artificial intelligence disciplines. Once again, the reader is advised to examine full-length treatises on lean thinking, value stream management, product orientation, Scaled Agile Framework (SAFe), Scrumban, Kanban, DevOps, DevSecOps, Continuous Integration, Continuous Delivery, etc. However, don't underestimate the powerful simplicity, efficiency, and effectiveness of the lean thinking principles outlined here, and be careful with crude models that ignore holistic thinking, automation, or saddle organizations with excessive ceremonies. Nothing substitutes for utter simplicity, small teams, deep multidisciplinary high-technology skills, rich conversations, informal but highly structured techniques, rich visualizations, and large doses of collaboration, improvisation, creativity, and daily improvement. Of course, courage, measured risk taking, and rapid deployment of software-intensive microservices using DevOps goes a long way too, while steering clear of large, bureaucratic, capital-intensive brick-and-mortar ventures with highly legalistic contracts.

Almost important as the lean thinking principles we have exhaustively outlined throughout this treatise is what we have not covered nor deemed critical to organization success through the delivery of innovatively new high-tech products and services. These include a traditional integrated master schedule (IMS), enterprise architecture (EA), business requirements, program or project management plan, earned value management (EVM), linear enterprise engineering life cycle (ELC), and documentation. Also not included are endless all-day meetings and ceremonies, full-utilization, full-capacity, multi-tasking, overallocation, multi-project management, micromanagement, thousand-page process guidelines, high-power distance, fear, threats, and punishment. Furthermore, we have not fully elucidated, illustrated, nor elaborated upon even more important non-traditional thinking principles such as the critical success factor (CSF) of emotional intelligence (EI), social skills, and autonomous bottoms-up decision making. That is, rather than executives forecasting strategic goals and objectives to which employees must obediently satisfy and comply, 21st century lead leaders must elicit strategic goals and objectives from employees, markets, customers, and other stakeholders. So much for forcing workers to blindly satisfy rigorous strategic plans, roadmaps, enterprise architectures, business requirements, process models, document standards, automated workflow tools, and other fabricated models of unpredictable customer needs.

Lean thinking is not just about incremental improvements to traditional capital-intensive manufacturing industries to yield minor improvements in operating efficiency, revenues, profits, and performance improvements of outdated products and service ideas. Lean thinking is about shifting resources away from putting lipstick on the 20th century pig to disrupting global markets with radically new product and service innovations that obsolete outdated technologies and ideas to leapfrog one's market competitors. Gone are the days when technological obsolescence ensues before complex, multi-billion-dollar, decade long products and services can be completed, assuming they could be completed at all with 70% to 90% failure rates for transformation initiatives. Lean leadership replaces traditional leadership bent on maintaining the status quo, giving lip service to traditional principles and practices, if at all, and simply watching business value erode year after year while delivery teams struggle to keep up or catch up. Lean leadership is about supercharging new product and service delivery performance, creating innovatively new product and service designs based on untapped creative potential of knowledge workers freed from slavery to traditional thinking principles. Lean leaders don't just swab the deck of a sinking battleship, but pioneer unprecedented new products and services to disrupt markets for expensive and unnecessary battleships, not with war machines, but by beating swords into plowshares so to speak.

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Case Studies in Lean Leadership

- **Software Radios**. *The first case involves a multi-billion-dollar software radio acquisition program for a large U.S. government agency with an annual budget of nearly $200 billion. At the outset, the government agency needed to modernize its custom mission critical radio communication devices. That is, this government agency recognized the strategic nature of radio communication devices for conducting missions of global significance for decades and had in fact, not only identified strategic goals for modernizing radio communications but established enterprise-level portfolios and value streams for doing so. Executive leaders at the highest-level of the organization recognized and supported not only strategic investments of significant portions of their annual budget to modernized radio communication devices, but personally created and oversaw the value streams and transformation and modernization initiatives within them, along with strategic acquisitions. In the early 21st century, the highest-level executives recognized the strategic organizational value of not only creating modern radio communication devices but substituting traditional hardware-intensive components for highly modularized software-based microservices and lean thinking principles for creating them as quickly and cost-effectively as possible. Small cracker-jack cross-functional teams of Ivy League educated electrical engineers were quickly assembled, lean practices quickly established, small user stories were created, and software microservices were quickly designed and implemented one at a time representing over 95% of traditional hardware-intensive components. The radio platform itself was nothing more than a metal or plastic case with a microprocessor, memory, long-lasting lithium battery, and a small touch-screen plasma display not unlike modern smartphones. More importantly a continuous integration, continuous delivery, and DevOps automation pipeline was quickly established as well. Programmers quickly coded small microservices not unlike modern smartphone apps and checked them into state-of-the-art automated version control repositories. From there continuous integration servers automatically detected these code commits, modules were automatically compiled, assembled and built, and millions of automated tests were run in fractions of a second. If a programmer's commit didn't break the build and all tests passed successfully, microservices were automatically deployed to dozens of software radio variations configured for unique global communication missions. One microservice at a time, the small cross functional team of cracker jack electrical engineers amassed a total base of millions of lines of thoroughly tested ultra-reliable code in a matter of months that otherwise would have required thousands of programmers nearly a decade using manual traditional process and document-driven lifecycles without similar quality, reliability, and availability. What was unique about this case was that a decade later most U.S. Fortune 500 firms had still not adopted these techniques.*

- **Education Platform**. *By 2010, a leading information technology firm of educational workflow delivery systems had reached its market peak. It had amassed a software base of tens of millions of lines of code and dozens of market leading products. Using the best outdated techniques of the late 20th century, it hired market leading enterprise architects to slowly integrate the entire code base into one highly interdependent skyscraper sized ball of yarn all in the name of code quality, reuse, and testability. In fact, they'd achieved exactly the opposite, because the massive, highly-interdependent enterprise architecture was so complex that it took years to document and understand, it was flaky and brittle, no one was allowed to touch the code base, and when they did, it took days, weeks, months, and thousands of hours to compile and build. Over 80% of the workforce was comprised of manual quality assurance testers, no new products or services had been created in years, customers abandoned their products and services in droves, and market share eroded quickly. All productivity came to a screeching halt and over 80% of the code base did not perform any useful value adding function or service except serve as interfaces for gluing the entire ball of yarn together into one massively complex enterprise architecture. Executives challenged the lowest level information technology workers to somehow untangle the mountain of yarn in order to improve productivity by a few percentage points. Empowered by this initiative, low level programmers scanned the marketplace, discovered the strangler application and domain driven design, and began breaking apart their decade long enterprise architecture into a service-based architecture along product lines. But, they didn't stop there, they continued disintermediating the service-based architecture into a microservices based architecture, until all that was left was a small family of loosely couple software modules. In doing so, these low-level programmers eliminated over 80% of the wasteful, unnecessary and unneeded non-value-adding code base, and individual microservices could now be compiled in seconds. They continued improving and self-instituted continuous integration, continuous delivery, and DevOps practices to automate deployment of fully tested and validated microservices from the fingertips of developers to customer platforms and services in seconds and minutes. Using this new state-of-the-art lean thinking paradigm, microservices ecosystem, and DevOps pipeline, 80% of the manual QA testers were no longer needed, the firm could now invest in innovators to create new products and services, deployment times shrank from years to minutes, and productivity skyrocketed thousands of times within months. Revenues, profits, and market share stabilized, new products and services were quickly deployed, and customers recommitted themselves to investments in their educational platform based on state-of-the-art information technologies instead of outdated client-server technology from the 1990s.*

- **Electric Car**. *By the late 2010s, all-electric cars became technologically feasible. Of course, battery life was still an issue, along with technology maturity, power, speed, safety, reliability, comfort, affordability, and manufacturability. Most competitors up until this point manufactured hybrids due to battery and weight limitations, using combustion engines to accelerate, charge batteries, and provide extra power when needed. Although impressive advancements had been made, hybrids were still too heavy, underpowered, and unnecessarily complex. An innovative manufacturer decided to try something new, not unlike the concepts found in early high-performance clusters for creating globally scaled massively parallel cloud computing platforms. These early clouds were based not on expensive and exotic liquid hydrogen cooled super computers, but commodity components such as motherboards, microprocessors, memory, and hard drives. Wired together in close proximity, inexpensive high-performance clusters were assembled with the power of super computers with lower cost and better performance. An automobile innovator decided to repeat this success story, create a lightweight and highly durable car frame and power it with thousands of tightly clustered commodity smart phone batteries. Allocating 95% of the car's functions to software-based microservices and onboard computers instead of traditional mechanical components necessary for combustion engine-based automobiles, the all-electric car basically became a large smartphone engineered by computer programmers versus mechanical engineers. Unusually high performance resembling more expensive sports cars was extracted from the massively parallel cluster of batteries and lightweight automobile construction. Furthermore, maintenance switched from oil changes and lube jobs to wirelessly updating microservices hundreds of times per day using cellphone towers as drivers operated their all-electric vehicles. The automobiles had many advanced safety features like anti-collision sensors and even self-driving features minimizing the risk of human induced automobile accidents. Microservices comprising over 95% of the all-electric automobile's components could be updated, optimized, corrected, and performance tuned by programmers in real-time without the need to replace the components or inconvenience automobile owners with taking time off from work or stranding their cars in maintenance shops for days or weeks, decimating operator maintenance costs and stressful wait times. Based on precision high-performance analytics, simulations, and models, microservices could be instantly updated at will to optimize and maximize battery life, engine power, customer convenience, safety, and overall ease and convenience of driving. These all-electric vehicles disrupted the global automobile ecosystem sensitive to minor fluctuations in market prices, supplier components, natural resources, fuel prices, import and export duties, manufacturing labor costs, and other capital-intensive investments.*

See: Rico, D. F. (2019). Business value of CI, CD, & DevOpsSec: Scaling up to billion user global systems of systems, http://davidfrico.com/rico19c.pdf