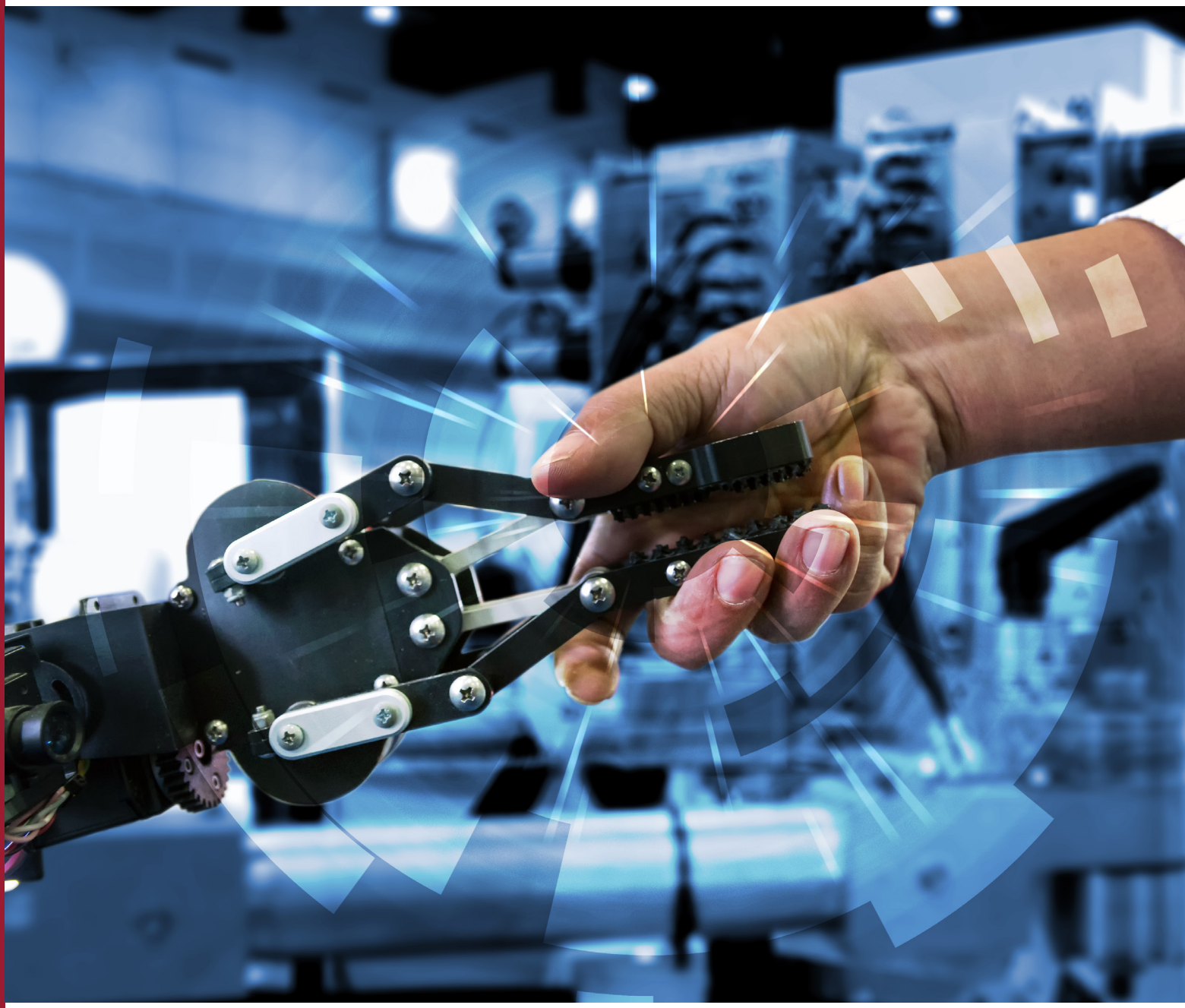
FOUR PRINCIPLES
An Abdul Latif Jameel Company



INDUSTRY 4.0 AND LEAN PRINCIPLES: A PARTNERSHIP TO SECURE DIGITAL SUCCESS

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SUCCESSFUL BUSINESSES ARE CONTINUALLY STRIVING TO BOOST SPEED, EFFICIENCY, AND PROFITS BY OPTIMIZING THEIR INCREASINGLY COMPLEX OPERATIONS—REGARDLESS OF INDUSTRY. TO STAY AHEAD IN TODAY'S COMPETITIVE BUSINESS ENVIRONMENT, FIRMS FACE ONGOING PRESSURE TO DELIVER GAINS IN PRODUCTIVITY, QUALITY, AND CUSTOMER SERVICE. IN RECENT YEARS, THE CATCHPHRASE "INDUSTRY 4.0" HAS COME TO REPRESENT THE NEXT WAVE OF OPPORTUNITIES FOR AMBITIOUS BUSINESSES. HERE WE'LL EXAMINE IMPORTANT ELEMENTS OF INDUSTRY 4.0 AND HOW IT RELATES TO DIGITALIZATION. WE'LL ALSO COVER HOW DIGITAL TRANSFORMATIONS CAN GO AWRY AND ILLUSTRATE HOW LEAN MANAGEMENT PRINCIPLES CAN LAY THE FOUNDATION FOR SUCCESSFUL ADOPTION OF INDUSTRY 4.0.

KEY COMPONENTS OF INDUSTRY 4.0

Industry 4.0 is named as such to represent the fourth significant upheaval in modern manufacturing, following the introduction of mechanical manufacturing systems in the late 18th century, mass production and electrical energy in the 20th century, and electronics-driven automation in the 1970s. The vast majority of the disruptive trends encapsulated in Industry 4.0 are related to advances in digital technologies.

Consider these examples:

- Big data – Companies are now able to gather more data and make better use of it. An African mining company identified ways to capture more data from its sensors, which showed unexpected fluctuations in oxygen levels during a key process. Correcting this issue increased yield by 3.7%, valued at up to $20 million each year.

- Advanced analytics – Product development can be drastically improved with more comprehensive analytics. One auto manufacturer uses data from its online car configuration tool combined with purchasing data to identify options for which customers are willing to pay a premium. Armed with this information, the company significantly cut the available options on one model to one-third the amount available from a competitor. Development time and production costs decreased significantly, and gross margins improved meaningfully over the next 24 months.

- Human-machine interfaces – A logistics company created a picking system driven by augment reality. Pickers wear a headset that displays key information, helping them find items more quickly and precisely, while keeping both hands free to build more efficient packages. Plus, an integrated camera captures serial numbers for real-time inventory tracking. The company saw error rates decline by 40%.

- Digital-to-physical transfers – A young, low-volume auto manufacturer builds cars almost entirely through 3-D printing. It has the ability to build a new model from scratch in one year—much quicker than the industry average of six years. Large incumbent manufacturers, such as GM, also use 3D printing and rapid prototyping to accelerate their time to market.

- Sophisticated sensors – In the pulp and paper industry, remote temperature sensors monitor key indicators, while state-of-the-art tools analyze and automatically adjust the intensity of the kiln flame. The technological advancements have resulted in fuel savings of up to 6% and a throughput increase of 16%.

And the list goes on. The digital levers of Industry 4.0 are vast, ranging from digital performance management and remote monitoring to smart energy consumption and predictive maintenance—all of which create value by generating improvements in quality, asset utilization, time to market, and management of resources and labor.

"By the time a transformational force such as Industry 4.0 becomes fully obvious, it's nearly too late. It's imperative that companies act now—waiting too long could significantly hinder growth and profitability." says James Ryan, Principal at Four Principles.

DIGITAL TRANSFORMATIONS OFTEN FACE AN UPHILL BATTLE

The potential benefits of Industry 4.0 are impossible to ignore—but going digital doesn't always go smoothly: 84% of digital transformations fail and only 50% of companies are successfully executing on their digital transformation strategies, despite demonstrated efforts and investments. In monetary terms, it is estimated that large enterprises throw away an average of $400 billion per year on digital transformation projects that fail to deliver promised benefits.

It's not difficult to come across high-profile examples of digital transformations gone wrong:

- Lego, a large toy manufacturer, defunded its proprietary Digital Designer virtual building program and stopped providing updates in 2016. Released in 2004, the program was part of a strategy to improve customer experiences based on automated instructions for customized models.

- Sportswear company Nike cut its digital unit in half in 2014 and shut down its wearable-hardware efforts, as the company struggled to create a premium experience that consumers would pay for in a competitive field.

- Broadcasting company BBC abandoned its £100 million digital innovation project, which was intended to transform the way staff developed, used, and shared video and audio material. The company's director general admitted it had "wasted a huge amount of license fee payers' money."

"When digital transformation is done right, it's like a caterpillar turning into a butterfly. But when done wrong, all you have is a really fast caterpillar." George Westerman, Research Scientist at the MIT Center for Digital Business.

Digital transformations can face several pitfalls. To successfully capture the benefits of Industry 4.0 and its related digitalization, companies must transform the way they do business—it's not just a matter of bolting on new technology. *"Industry 4.0 requires foundational changes in infrastructure, project design, business processes, and people operations, which becomes a very complex endeavor when done properly, benefiting from Industry 4.0 also requires commitment from top leadership, and continuous monitoring and improvement."* says James Ryan, Principal at Four Principles.

OPTIMIZING OPERATIONS WITH INDUSTRY 4.0 AND LEAN PRINCIPLES

The principles of Lean management are designed to support the objectives of operational excellence and are highly relevant in the context of Industry 4.0. *"Manufacturers striving to optimize their operations by adopting Industry 4.0 trends can do so most effectively by integrating Lean management principles. We believe this holistic, two-part approach generates the most impact and captures the greatest benefits,"* says Stefano Gaspari, Principal at Four Principals, *"Mutual enablement promotes benefits beyond Industry 4.0 alone."*

Proven principles of Lean thinking are fundamental in effectively implementing Industry 4.0. For example, successful digitalization requires transformational thinking throughout the organization—not just in the IT department. Lean considers the company as a whole by assessing entire value chains, removing waste, launching and learning from flagship pilot projects, and supporting continuous innovation through the creation of new behaviors.

COMBINING AUTOMATION AND HUMAN INTELLIGENCE

Lean's deep history in automation—tracing back many decades to the Toyota Group—is particularly relevant, as companies stand to capture noteworthy benefits from Industry 4.0 advancements in automation.

In the Lean lexicon, "Jidouka" represents the combination of automation and human intelligence, or, in other words, automation with a human touch. Jidouka is a key pillar of the Toyota Production System and traces its roots to the early 1900s, when Sakichi Toyoda invented a simple mechanism that could detect a broken thread and shut off an automatic loom. The invention empowered one operator to oversee many looms while upholding high quality standards.

With jidoukain the modern world, an automated machine is enabled to detect a problem, communicate it, and stop the production line. The human manager then fixes the problem, and improvements are incorporated into the standard workflow. Under the Jidouka model, no defective products are manufactured, since the line stops—and a single operator can monitor multiple machines, since they are designed to stop automatically, which results in drastic improvements in productivity. In the digital world, software integration now allows companies to analyze masses of data in real-time, including production status and energy consumption. These advancements in automation mean resources are quickly redistributed, saving costs, and making production systems more flexible.

Mechanical engineering company Bosch Rexroth, for example, is building "the factory of the future", where everything is connected from field level to cloud-based IT systems. Sophisticated software solutions collect, transfer, and process data from automated manufacturing processes for humans to analyze and optimize. The company places humans at the center of its efforts as users, designers, and decision-makers. This constant exchange of information fosters intelligent collaboration and flexibility—which ultimately benefits Rexroth customers, who enjoy lower unit costs and the economical production of batch sizes as small as one item.

"I think we can expect superb products of enormous variety and flexibility–not just for manufacturers, but for their customers in turn. What's more, it will be increasingly possible to make these products to a very high quality and under very economical conditions. One more thing. In a world of up to 10 billion people, customization will be the big unique selling proposition–and the Factory of the Future will make it possible". Rolf Najork, President with responsibility for development, Bosch Rexroth

Industry 4.0 and Jidouka are not limited to manufacturing settings. Consider this example of a health care provider that successfully implemented the Lean principle of human-centered automation within the Industry 4.0 landscape:

Seattle-based nonprofit regional health care provider Virginia Mason employed Jidouka to integrate bar-code medication administration (BCMA) technology into the nursing workflow with minimal disruption. With BCMA, a nurse scans the barcode on a patient's wristband to verify the patient's identity, then scans the bar code on the medication to ensure the right medication is being administered with the proper dosage, technique, and timing. While the bar code provides valuable information, the nurse holds the ultimate decision-making power. BCMA represents the digital automation, while the nurse's intelligent human judgment completes the Jidouka concept. After BCMA implementation, the number of safe-practice dosage violations decreased from 54.8 to 29 per 100 doses, and the number of medication errors decreased from 5.9 to 3 errors per 100 doses.

When it comes to adopting Industry 4.0, the time-tested principles of Lean, such as Jidouka, lay an important foundation for success. If your company is ready to embark on a transformational digital journey, Four Principles is here to deliver tangible Lean Management Expertise, not idle talk. We develop sustainable Lean Solutions across various industries throughout the world. We implement. We are passionate about what we do. We are Lean experts. Learn more at https://fourprinciples.com/.

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GET IN TOUCH

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LEAN INDUSTRY 4.0

WHAT IS INDUSTRY 4.0?

Industry 4.0 refers to the fourth industrial revolution. It is the use of advanced digital technologies to radically improve both efficiency and effectiveness of industrial and non-industrial operations.

The foundation of 'Jidoka' or Automation is laid by Sakichi Toyoda in 1896 and moved forward by Lean practitioners applying new technologies

自働化*

Lean progression through industrial evolution

1896

1784
Initial mechanisation through water and steam powered machines

1870
Mass production, interchangeable parts and assembly powered machines

1969
Individualized production through computer automation and/or automated machines

2011
Cyber physical systems capable of real-time planning and control of production plants, along with dynamic self-optimization through the Internet of Things with minimum human intervention

*Jidoka or Automation is a pillar of Lean and the Toyota Production System that puts humans in the center, using technology to enable customers & employees who serve them.

WHY DOES COMBINING LEAN AND INDUSTRY 4.0 MAKE SENSE?

Lean provides the essential elements for enabling the successful implementation of Industry 4.0, while Industry 4.0 provides the tools to maximize the impact of Lean improvements.

INDUSTRY 4.0 ELEMENTS

- Real-time information
- Unique specifications per product
- Intra-machine communication
- Adaptive demand and supply planning
- SMART OPERATOR
- SMART PRODUCT
- SMART MACHINE
- SMART PLANNER

LEAN ELEMENTS

- VALUE FOCUS — Focus on customer value
- PEOPLE CENTRIC — Jidoka (human centered approach)
- TRANSPARENCY — Performance made transparent by all
- CONTINUOUS IMPROVEMENT — Culture backed by process

40%

INDUSTRY 4.0 ONLY	LEAN INDUSTRY 4.0	LEAN WITHOUT AUTOMATION & DIGITIZATION
13%	48%	18%
Low implementation	Leans on Industry 4.0	Only implemented lean

Extra 9% through mutually enabling integrated approach

Combining the elements of both Industry 4.0 and Lean increases the return on investment and decreases implementation risks.

WHAT IS THE RATE OF INDUSTRY 4.0 ADOPTION IN KSA COMPARED TO OTHER COUNTRIES?

Even though the worldwide market is advancing, the investment in digitalization in KSA currently lags the leading markets by between 25% and 50%.

+4.1%

By implementing Industry 4.0, companies in leading markets increase manufacturing efficiency by an average of 4.1% annually

*Year over year

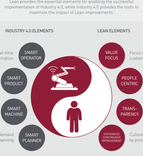
HOW IS INDUSTRIAL DEMAND IN KSA EXPECTED TO DEVELOP IN THE COMING YEARS?

There will be a shortfall of more than 5% in expected consumer spending growth up to 2020, consumer spending being a good proxy for industrial demand

-1.7%

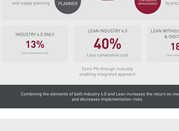
Research products that due to recent changes in KSA consumer spending growth will be only 1.8% up to 2020 falling short of the previously expected 7%

*Year over year



WHAT DO THESE TRENDS MEAN FOR INDUSTRIAL COMPANIES IN KSA?

Due to the compound effect of efficiency gains from applying Industry 4.0 and increasing market competition, non adopters will very quickly find themselves left behind



WHICH COMPANIES HAVE SUCCEEDED USING A LEAN INDUSTRY 4.0 APPROACH?

The biggest challenges in implementing Lean Industry 4.0 center around internal issues such as culture, organization, leadership and skills rather than external and funding issues.

adidas

Using Lean Industry 4.0, Adidas reduced the time-to-market every year by 50%

1st	160	15%
In company now to utilize robotics and 3D printing in the footwear Industry 4.0	Machines now producing 1,000 pairs of shoes a day or 500,000 annually	Expected increase in sales due to Lean Industry 4.0 processes

Lean Industry 4.0 helped in the turn-around of the company to achieve the highest growth rates and profitability metrics in the sector

Harley-Davidson

97%	50%	91%
Reduced manufacturing lead time from 21 to just days cycle in 6 hours	Reduced Industry 4.0 the efficiency achieved flexibility to handle 30% fluctuation in production annually	Improvement in overall manufacturing productivity over 5 years

GE

GE invested $2 billion in reshaping it's plants using Lean Industry 4.0 with six sigma tools and processes.

80%*	30%*	100M*
Reduced required production area by 80% and increased efficiency per sqm on plant production line	Increased labour efficiency by 30% on plant production line	Yearly savings in production worldwide

*Performance improvements 2014 vs. 2016

General Electric

Factory budgets have been increased by 20% to modernize production according to Lean Industry 4.0 standards

25 years	21M	3.7M
Our 25 year operations have been made to ensure the company is 'connected enterprises' level	Achieved USD 21M savings from reduction of waste material after modernization to Industry 4.0	Evaluating Lean and Industry 4.0 approached energy savings of 4% resulting in USD 3.7M annual savings

SIEMENS

'sandbuoyantes', paperless data exchange reduced lead times & increased quality within processes

75%	100%	96%
Automation rate in pilot factory producing over 12 million units per year	99 PRIMERS of produced products are made using the quality standards	Reduced lead time in production process from 120min to 5min due to improved data exchange

HOW CAN FOUR PRINCIPLES HELP WITH THE CHALLENGES IN IMPLEMENTING LEAN INDUSTRY 4.0?

Four Principles has both the methods and experience to support companies in both laying the groundwork, applying the technology and driving the change to get the maximum benefit from Lean Industry 4.0.

7 INDUSTRY 4.0 COMMON CHALLENGES

- Lack of digital culture, training and skills
- Large investment without clear financial benefits
- Hidden costs due to digitizing waste
- Lack of adequate maintenance programs
- Machine centric, Excluding the human factor
- Unclear digital operations management and standards
- Incapability to integrate with business partners
- Silo mentality
- Lack of systematic continuous improvement

LEAN INDUSTRY 4.0 FRAMEWORK

THE FOUR PRINCIPLES PHASES OF LEAN INDUSTRY 4.0 IMPLEMENTATION

1. MATURITY ASSESSMENT	2. DEFINE REQUIREMENTS & SOLUTIONS	3. PILOT & BUILD RESILIENCE	4. IMPLEMENT & ADAPT SOLUTIONS
Assess each Industry 4.0 element against each Lean element	Define how & where Lean Industry 4.0 'Use Cases' can support both customer and staff	Develop solutions and challenge them in pilot phases and use cases	Successful solutions are implemented and assessed continuously to ensure efficiency and effectiveness

WHAT RESULTS HAS FOUR PRINCIPLES ACHIEVED IN IMPLEMENTING LEAN INDUSTRY 4.0?

Using our Lean Industry 4.0 framework and implementation approach, Four Principles has enabled clients in the region to achieve significant results.

Projects averages of Lean Industry 4.0 implementation success stories

-37%
Overall Time to Market Reduction

32%	41%	85%
Supplier to factory and factory to customer	Factory conversion	Data transfer and migration

+28%
Overall Productivity Increase

19%	34%	27%
Reporting cycles and real-time data availability	Standardization	Digitalization and automation of necessary non-value added activities

+56%
Overall Capacity Increase

43%	46%	27%
Centralized processes and touchpoints	Mechanical and digital changeover reduction	Stoppage time, layout, and material/informational flow

-14%
Overall Realized Cost Savings

43%	21%	13%
New product development	Conversions productivity, FTE and lead time	Maintenance and quality