Deep Learning Playbook for Manufacturing Industries

How to Lead Your Company Into the AI Era

Manufacturers rely on automation technologies such as machine vision, robotics, and artificial intelligence (AI) to improve efficiency, increase throughput, and ultimately drive revenue. Of all these manufacturing technologies, AI (called deep learning or machine learning in machine vision) may have the greatest impact. Between now and 2030, AI technology is expected to create an estimated $13 trillion in global GDP growth. While some of that value has already been realized by leading technology companies such as Google, Baidu, Microsoft, and Facebook, much of the additional waves of value creation will go beyond the software sector. Manufacturing is expected to be one of the largest beneficiaries of deep learning (DL) technology, as the technology enables applications that were once considered impossible to automate while boosting productivity gains.

PLAYBOOK STEPS

1. Acquire/Develop AI Expertise
2. Choose Wisely to Manufacture Momentum
3. Empower Your Employees with Knowledge
4. Develop a Long-term AI/DL Strategy
5. Share AI Successes

This Deep Learning in Manufacturing Playbook draws on the work of Andrew Ng, developer of the Google Brain team, the Baidu AI Group, and Landing AI. The playbook delivers insights into what manufacturing companies should consider prior to deployment of AI and how a data-centric, machine-learning approach to AI system design reduces risk, increases efficacy, and enables the type of continuous learning that is so important to manufacturers, which must always add new products and adapt to changing production environments.

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1. Acquire/Develop AI Expertise

Systems integrators and consultants well versed in deep learning can help manufacturers gain initial momentum with AI solutions, but long term, companies should develop expertise in-house to maximize their productivity returns. While integrators can be great force multipliers when it comes to an internal AI development team, some projects need to stay within the company to build a unique competitive advantage.

2. Choose AI Projects Wisely to Manufacture Momentum

Whether you're deploying your first AI/DL solution or adding another to the plant floor, the project must demonstrate effectiveness and value. The project should be meaningful enough that initial successes will help the company gain familiarity with the technology and data-centric development processes while also convincing others to invest in further deep learning projects. The project should not be so small

Consistent high quality product is the goal of every manufacturer, and their AI/ML teams realize that focusing on better data will drive better models which leads to faster and more reliable results.

In the AI era, a key moment for many manufacturing companies is the formation of a centralized AI team that can help the whole business. This team could report to the CTO, CIO, or CDO (chief data officer or chief digital officer) or it could be led by a dedicated CAIO (chief AI officer). Key responsibilities of an AI unit might include:

- Build up internal deep learning expertise to support the whole company.

- Execute an initial series of high-return projects to gain visibility among key business groups.

- After completing initial projects, set up repeated processes to simplify and expedite future projects.

- Develop consistent standards for recruiting and retention, including unified data warehousing standards.

that others consider it trivial. The most important thing is to get the flywheel spinning to gain momentum. Considerations for the first few deep learning projects:

- The AI model should be evaluated against human inspectors to prove its value before deployment to a production line. This is generally referred to as human in the loop (HIL), especially if the line is a test for global deployments. At best, AI development platforms for manufacturing accommodate expert human guidance at the data labeling stage.

- A new or external deep learning expert, such as a systems integrator, should be able to partner with internal teams with deep domain knowledge to build AI solutions that start showing traction within six to 12 weeks.

- The projects should be technically feasible. Many companies seek to deploy deep learning in applications where it simply won't work. Having a trusted expert perform a feasibility study up front using a fast AI application development tool such as Landing Lens will increase the likelihood of success and avoid wasted time, effort, and costs.

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3. Empower Your Employees with Knowledge

Finding the right talent is critical in industrial automation. Just as finding the right person for VHDL programming on FPGAs is difficult, finding AI talent is difficult too. Fortunately, many digital platforms can help. These include MOOCs (massive open online courses such as Coursera), trade publications, webinars, virtual conferences, ebooks, and YouTube videos, all of which can help train large numbers of employees in AI/DL. A smart chief learning officer (CLO) will curate rather than create content and then establish processes to ensure that employees complete the learning experiences.

Digital content provides an affordable and personalized experience for employees. If your company has the budget to hire consultants, in-person training can complement online content. When implemented correctly, this "flipped

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classroom" pedagogy results in faster learning and a more enjoyable learning experience. Ng used this form of pedagogy at Stanford in his on-campus deep learning class. Similarly, hiring a few AI experts to deliver in-person content will motivate your employees to learn AI techniques.

Consulting with an expert allows you to develop a customized curriculum for your team. Education could range from just a few hours of basic training for executives to up to 100 hours of technical training for engineers working on AI projects.

4. Develop a Long-term AI/DL Strategy

It's hard to build a successful strategy without a solid foundation of knowledge. Many manufacturing companies want — or have tried — to deploy an AI/DL strategy, but this usually can't be done without some basic experience with deep learning. The following steps help provide the foundation necessary for developing a successful AI/DL strategy.

Strategic data acquisition: Data is the most important asset for deep learning systems, which is why Landing.ai promotes a data-centric AI development workflow. Useful AI/DL systems can be built with anything from 100 data points (small data) to 100,000,000 data points (big data). Having more data almost never hurts, but the data must be appropriate, correct, and consistent. Systems with error-checking tools can help manufacturers manage their data and engineer success through AI/DL.

Recognize what data is valuable and what is not: Having many terabytes of data does not automatically mean that AI/DL software can create value from that data. Early in the process of data acquisition, prioritize what types of data to acquire and save. For example, in visual inspection applications on the production line, companies must decide up front what defines a defect or a passing part. The more accurate the data — along with consensus among expert inspectors and repeatable data labeling processes — the better the AI/DL machine vision inspection system.

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5. Share AI Successes

AI/DL can have significant impacts on your business. Since this affects your key stakeholders, you should run a communications program to ensure alignment. Here is what you should consider for each audience:

Investor relations: Leading AI companies such as Google and Baidu are so valuable in part because of their AI capabilities and the impact AI has on their bottom lines. Explaining a clear value creation thesis for AI, describing your growing AI capabilities, and having a thoughtful AI strategy will help investors value your company appropriately.

Government relations: Companies in highly regulated industries (self-driving cars, health care) face unique challenges to stay compliant. Developing a credible, compelling AI/DL story that explains the value and benefits of your project is an important step in building trust and goodwill. This should be coupled with direct communication and ongoing dialogue with regulators as you roll out your project.

Talent and recruitment: Because of the scarcity of AI talent, strong employer branding will have a significant effect on your ability to attract and retain such talent. AI/DL engineers want to work on exciting and meaningful projects. A modest effort to showcase your initial successes can go a long way.

Internal communications: Because AI/DL is still poorly understood and because artificial general intelligence specifically has been overhyped, there is fear, uncertainty, and doubt. Many employees are concerned about their jobs being automated, though this varies widely by culture. (For , this fear appears much more in the United States than in Japan.) Clear communications both to explain AI and to address employee concerns will reduce internal reluctance to adopt the technology.

Learning From a Digital Past: Final Insights from Landing AI's Andrew Ng

Understanding how the internet transformed industries is useful for navigating the rise of AI. We can learn from mistakes that many businesses made when trying to navigate the rise of the internet. For example, we learned in the early internet era that:

shopping mall + website ≠ internet company

If a shopping mall builds a website and sells things on that website, that by itself does not turn the shopping mall into a true internet company. A true internet company is able to do things that the internet lets a business do really well. For example, internet companies engage in pervasive A/B testing: they routinely launch two versions of a website and measure which works best. An internet company might even have hundreds of experiments running at the same time; this is extremely hard to do with a physical shopping mall. Internet companies can also ship new products every week and thus learn much faster than shopping malls, which might update their products only once per quarter. Internet companies also have unique job descriptions for roles such as product manager and software engineer, and those jobs have unique workflows and processes.

The growth of deep learning shows many parallels to the rise of the internet. Today we find that:

$$\text{typical company} + \text{deep learning technology} \neq \text{AI company}$$

For your company to become great at AI, you have to organize it to do the things that AI lets you do really well. For your company to be great at AI, you must have:

- Outsourced and/or in-house technology and talent able to systematically execute on multiple AI projects that deliver direct value to the business

- Sufficient understanding of AI, with appropriate processes to systematically identify and select valuable AI projects to work on

- Strategic direction: The company's strategy should be broadly aligned to succeed in an AI-powered future.

Turning your great company into a great AI company is challenging, but it is feasible with the support of great partners. The team at Landing AI is committed to helping partners with their AI journey, and we will continue to share additional best practices.

By investing in AI, you will stay ahead of your competitors and leverage AI capabilities to significantly advance your company.

About LandingLens

LandingLens is an industry-first data-centric artificial intelligence (AI) visual inspection platform. It helps improve inspection accuracy and reduce false positives. The end-to-end platform standardizes deep learning solutions that reduce development time and scale projects easily to multiple facilities across the globe. Our focus remains on our customers and continual product innovation to solve the real-world problems of the manufacturing audience. To learn more, visit: www.landing.ai and follow Landing AI on Twitter and LinkedIn.

About Landing AI

Landing AI™ is pioneering the next era of AI in which companies with even limited data sets can realize the business and operational value of AI and move AI projects from proof-of-concept to full scale production. Guided by a data-centric AI approach, Landing AI's flagship product is LandingLens™, an enterprise MLOps platform that offers to build, iterate, and operationalize AI powered visual inspection solutions for manufacturers. With data quality being key to the success of production AI systems, LandingLens™ enables users to achieve optimal data accuracy and consistency. Founded by Dr. Andrew Ng, co-founder of Coursera, former chief scientist of Baidu, and founding lead of Google Brain, Landing AI is uniquely positioned to lead the development of AI from a technology that benefits a few to a technology that benefits all.

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