

The Tech Executive's Primer On Data Science, Machine Learning, And AI

Spot Hype, Doomed Projects, And AI-Washed Solutions — And Provide The Leadership Your AI Teams Need

by Kjell Carlsson, PhD

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Why Read This Report

Data science, machine learning, and artificial intelligence (DSMLAI) are critical for your competitiveness because they help you transform any activity that involves data — i.e., every part of your business. All executives need to make strategic decisions about how and where to leverage these technologies, but few leaders have experience with them, so misconceptions abound, causing poor outcomes, wasted resources, and resistance to future initiatives. Use this guide to develop an executive understanding of DSMLAI: what it is, what it's for, what you need to do it, where to get it, and how to avoid the biggest failures.

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Machine Learning Requires More Human Learning (By Senior Executives)

Successful transformation with DSMLAI requires *simultaneous* business and technical leadership. You can build, buy, or hire technical expertise, but you need an executive understanding of DSMLAI in order to:

- **Pursue the right use cases.** Set yourself up for success by pursuing DSMLAI projects that are in the sweet spot of business value and technical feasibility. Unfortunately, you're likely to pursue ones that don't have either, thanks to the twin forces of science fiction and exuberant marketing. Thankfully, you don't need to be a data scientist, as a little DSMLAI literacy goes a long way to bridging the gap between your domain expertise and your technical experts — and maximizing everyone's return on effort.
- **Make the right investments.** The proliferation of AI solutions means there is plenty of real value hidden among the hype and AI washing, but which is which? Is the vendor suggesting old-school methods because they fit the use case or because the vendor hasn't invested in its AI chops? Your knowledge of DSMLAI will help you navigate the minefield of technologies and vendor offerings, helping you build, buy, or hire the right solutions.
- **Lead your initiatives to success.** AI and ML-driven transformation doesn't happen on its own. Even the most turnkey AI-embedded solutions involve significant implementation, customization, and change management, while bespoke solutions require cross-team collaboration, constant iteration in development, and ongoing management in deployment. Executives who take a hands-off approach do more to harm a new initiative than if they had cut funding.

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- **Advance your career.** If you could hire someone with the business and technical skills to lead your business using DSMLAI, they would replace you. These technologies are becoming critical parts of business activities across horizontals and verticals. One day, having experience with AI and ML transformation may become table stakes for all business leaders; for now, those with that experience are more sought-after than a GPU cluster at a Kaggle competition.

Boost Your Human Intelligence About Artificial Intelligence

Most DSMLAI terms are *not* what their names suggest (see Figure 1). In a nutshell:

- **Data science is about extracting meaning from data.** Data science uses analytics (reports and dashboards — aka business intelligence [BI]); advanced analytics (fancy visualizations and ML — aka augmented BI); and AI technologies (rules, statistical-, and deep-learning-based methods for analyzing text, speech, images, and video).
- **ML is about applying algorithms to data to train ML models.** It includes all statistical methods as well as additional methods from computer science (aka data mining). ML models are software code that detects and/or reveals patterns in data. For example, a data scientist can use a random forest method (algorithm) on customer attrition data to build (train) a churn prediction model. These models perform a range of different tasks on your data (see Figure 2).
- **ML models can reveal insights, make predictions, and power applications.** For example, a churn prediction model can reveal the characteristics of customers who are most likely to churn, forecast which of your customers are likely to churn, and power an application that sends discounts to customers who are likely to churn.
- **Supervised ML uses labelled data; unsupervised ML does not.** For example, a data scientist uses supervised ML on data with labels indicating which customers have and have not churned in order to build a customer attrition model. On unlabeled data (which has no information on which customers churned), the data scientist could use unsupervised ML to cluster customers with similar attributes into segments.
- **Deep learning (DL) is a type of ML that's especially good at text, voice, images, and logs.** DL (aka artificial neural networks) makes it possible to extract new, more accurate insights from unstructured data or combinations of diverse data at scale. For example, DL makes chatbots, smart speakers, and finding anything on YouTube possible thanks to DL-based intent recognition, transcription, and object detection models, respectively.
- **AI is an umbrella term for ML and automation methods used in new ways.** DL triggered the “AI revolution” when it became commercially feasible at scale after 2012. However, “AI” has also become synonymous with applying (non-DL) ML methods and automation techniques to drive business outcomes in new ways. For example, an “AI” solution that prioritizes leads, recommends content, and suggests next best actions for sales execs may not need any DL models.

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FIGURE 1 Commonly Confused Machine Learning And AI Terms

Artificial intelligence	VS.	Machine learning (ML)
Umbrella term for ML and automation used with new types of data, often in new ways and/or for new use cases		Computer science, statistics and other algorithms for identifying probabilistic relationships in data
Supervised ML	VS.	Unsupervised ML
ML methods that predict or detect known patterns or outcomes using automatically or manually “labelled” data		ML methods that surface relationships in data , without data about a pattern or outcome of interest
Deep learning	VS.	Reinforcement learning
A branch of ML, aka neural networks, that is particularly accurate on vision, language , and other types of complex data		ML approaches that test their way to optimal actions using simulated environments or micro experiments
Model	VS.	Algorithm
A piece of software code that detects and/or describes patterns in data		A defined sequence of computer implementable instructions
Accuracy	VS.	Precision and recall
A measure of ML model performance (share of accurate predictions) that ignores differences in impact of false positive vs. false negative predictions		Measures of ML model performance focused on minimizing false positives (precision) or minimizing false negatives (recall)
Bias	VS.	Fairness
Degree to which a model systematically makes errors — unrelated to positive or negative ethical impacts (is a ML/AI concept)		Degree to which a model's predictions are aligned with a set of ethical principles (not a ML/AI concept)

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FIGURE 2 Key Machine Learning Tasks

Task	Description	Example
 Classification	Predict an outcome or sort an observation into two or more discrete categories	Predict whether a customer will buy or leave
 Regression	Predict or determine a continuous range	Predict a customer's lifetime value
 Clustering	Sort observations into different groups based on similarities	Identify customer segments
 Anomaly detection	Identify wide-ranging exceptions	Detect fraudulent purchases
 Association rules	Detect "if-then" relationships	Identify products that customers buy together

The Hardest Parts Of AI And ML Have Nothing To Do With AI And ML (Mostly)

What do you need to build ML and AI solutions? It's almost guaranteed you'll need to invest in:

- **New data.** You might have lots of data, but odds are it is currently unusable for DSMLAI. It either is inaccessible; needs plenty of transformation and cleaning; needs human or machine labelling to indicate the pattern to predict; or needs to be augmented with new types of data that you'll have to collect or purchase — and that's just to train your model. When you deploy your model, you'll need to build new data pipelines to access that data in your production system. To pursue AI and ML at scale, you will need an agile information architecture that enables you to serve new types of data, in new ways, in a governed and repeatable fashion.
- **New people.** Yes, you will need data scientists and many more of them. However, it's more important to have the right types of data scientists for your use cases — such as applied statisticians for strategic analyses, ML engineers to build predictive models on big data, or computer vision or natural language processing (NLP) specialists — and using them as part of hybrid teams that can support and accelerate the entire project lifecycle. These hybrid teams will include data analysts, data engineers, developers, and ops professionals. As you scale your AI and ML ambitions, you will also need product managers who can manage relationships with stakeholders and shepherd projects to success.

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- **New processes.** All of these skilled roles need to collaborate across the AI and ML lifecycle — but they are often split across different parts of the organization, leverage separate tools, and have vastly different incentives. To be successful, you will need to align these parts of the organization and build new processes that enable repeatability and governance. Product managers trained in change management will help.
- **New technology.** Your different roles need tools: tools to access the data (pipeline, data marketplace, data prep, replication); to visualize the data (BI); to analyze data and train models (PAML); and to deploy and manage your models (ModelOps). You'll want different model development tools to help you democratize AI and ML (multimodal PAML); access the latest innovations (notebook-based PAML); and accelerate the AI and ML lifecycles (AutoML).

Improve Your Chances Of Success With Seven Best Practices

You can avoid most of the typical DSMLAI failures by heeding these best practices.

- **If it looks like what a layperson thinks AI should look like, you aren't doing it right.** The actual advantages and disadvantages of ML and AI technologies vary so dramatically from popular perceptions that if an idea, proposed solution, or vendor offering looks like something a layperson would expect, it will be doomed to fail, is overly hyped, or will have to rely on a person hiding behind a curtain. For example, augmenting complex human jobs with AI — such as AI tools that help nurses monitor and identify patients at risk — deliver extraordinary returns but will never feature in a science-fiction movie. Expect the same for high-potential real-world AI projects.
- **Prioritize projects in the sweet spot of business value *and* technical feasibility.** Start purely with the business value and you'll choose use cases that play to AI's weaknesses and miss its strengths (think fully autonomous vehicles). Start with the data and you'll find true but worthless insights (e.g., bookings drive revenue). Instead, scope projects based on their value and feasibility simultaneously. Bringing business and technical experts into the process is a start, but you'll improve success with "interpreters" who have experience in both worlds. In [Pick A Powerful Pilot To Propagate Customer Analytics](#), we show you how to prioritize pilot projects.
- **Plan with the full AI lifecycle in mind.** Your insights won't drive value unless they drive action — that is, end users adopt them. Usually, that involves deploying your AI solution, getting it into the hands of end users, and training folks. If you haven't planned for how that will happen, be prepared for lengthy delays at best; at worst, you'll discover that deployment is impossible. Increase your likelihood of success by planning your project from end to end and involving the solution's intended end users from the start and throughout the process. You'll be tempted to start experimenting and see what evolves. Resist this.
- **Improve your data iteratively.** When it comes to AI projects, quality data is a myth. You won't know what data you need and the form that you need it in until you know how you are going to use it — and vice versa. Don't hold your AI project back waiting for a major information architecture project

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to be completed. Even if the project is completed, odds are the data won't suit your requirements. Instead, work with the data that you can get hold of rapidly, drive the value you can quickly, and use the success to advocate for the next round of investment in your data assets and pipelines.

- **Improve your AI capabilities iteratively.** Just like with data, most successful DSMLAI initiatives take the capabilities that are available or can be rapidly acquired; deliver value quickly; measure and communicate that value; and use that success to justify investment in better skills, platforms, and processes as part of an ongoing virtuous cycle. That often means buying horizontal or vertical point solutions with embedded AI capabilities first and then going beyond the capabilities of these solutions using custom models and applications.
- **Actively counter your human biases and then worry about biased AI.** AI isn't biased; your people and data are. Actively seek out and counter biases in the data you want to use to train your models, and source multiple technical and subject-matter-expert perspectives on your projects. Above all, test multiple hypotheses, validate models, and monitor them over time for bias and, when applicable, fairness. If you do, your resulting models will almost certainly be less biased than human decisions. If you don't, you risk reinforcing and proliferating bias. In [The Ethics Of AI: How To Avoid Harmful Bias And Discrimination](#), we show you how to identify and mitigate harmful discrimination with AI.
- **Kill zombie AI projects.** More than most projects, AI projects can persist in limbo either because powerful executive sponsors have set ill-conceived goals for them or because too few people in the organization understand AI well enough to spot the lack of progress. They lurch forward in perpetuity, consuming time and resources, driving away your best people, and deadening the organization to future innovation. Empower your teams to kill projects, but capture the learnings and resurrect them in new, more viable incarnations.

Continue Your Data Science, Machine Learning, And AI Education

How do you develop a next level business understanding of DSMLAI? Read the following reports to:

- **Understand the landscape of DSMLAI technologies and offerings.** Read [Shatter The Seven Myths Of Machine Learning](#) to avoid common ML myths and misperceptions (and spot ignorance in others). Read [Research Overview: Artificial Intelligence](#); read the Tech Tide reports that it mentions to understand the landscape of technologies; and read the linked Now Tech and Forrester Wave™ reports to evaluate different types of offerings.
- **Learn how to scale DSMLAI in your organization.** Understand the evolving roles and skills needed to leverage these technologies by reading [Evolve Data And Analytics Roles And Skills For The Adaptive Enterprise](#). Learn more about how to organize projects for success in [Best Practices: Scaling Data Science Across The Enterprise](#). Read [Q&A: Scale AI With Automated Machine](#)

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[Learning](#) to find out how to leverage AutoML to democratize and accelerate innovation with DSMLAI. Read [Introducing ModelOps To Operationalize AI](#) to learn about the capabilities needed to deploy, monitor, and govern ML and AI models at scale.

- **Discover how ML and AI are evolving.** Read [The Future Of Machine Learning Is Unstoppable](#) to find out how enterprise usage of AI is developing. Read [AI 2.0: Upgrade Your Enterprise With Five Next-Generation AI Advances](#) for the most impactful technological advances in AI that are now becoming commercially available.

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