人工智能驱动的需求预测

求预测

面向未来的思考：o9
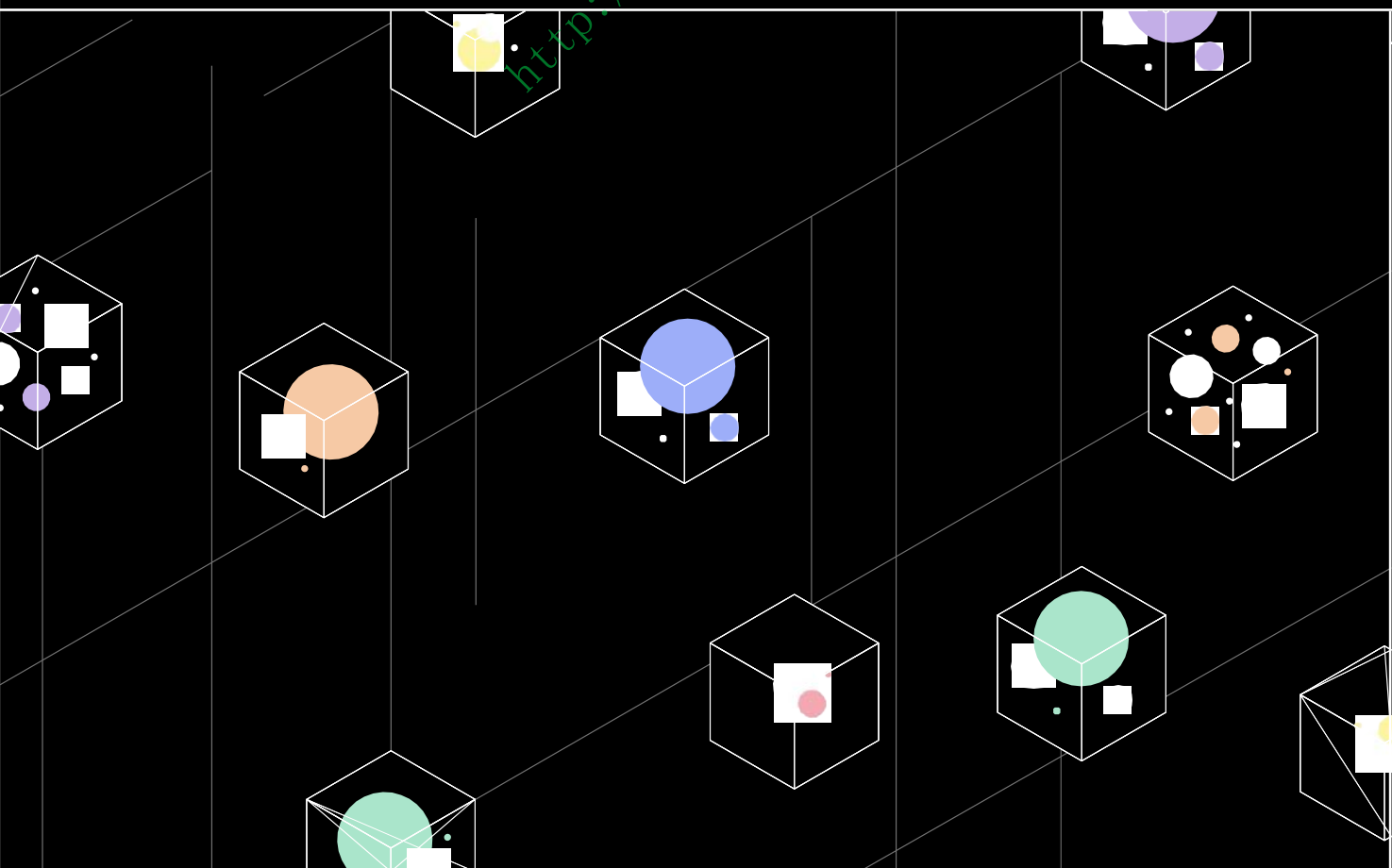
的数字大脑

白皮书

介绍

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它 预测 、

其 需求 驱动

复杂 和 不确定
缓慢 和 孤立 的 运营 以及
允 许价值 的
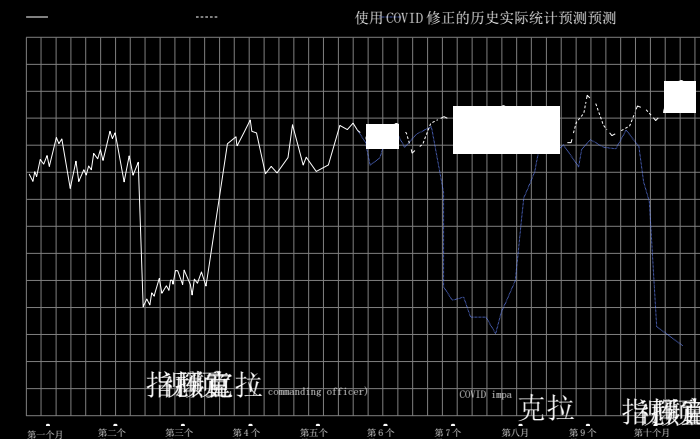
如今，供应链正受到变革的冲击。消费者需要价格有竞争力的最佳产品选择，以及快速交货和定制选项。

　与此同时，世界面临着气候变化、贸易紧张、资源稀缺、两极分化的政治、网络攻击、COVID、欧洲冲突、由此引发的燃料和粮食危机、通货膨胀以及对衰退的担忧所带来的不确定性。

使用COVID修正的历史实际统计预测预测

指挥官拉 commanding officer　　克拉　指挥官拉 commanding officer

第一个月　第二月　第三月　第四月　第五月　第六月　第七月　第八月　第九月　第十个月

预测是一个组织的命脉，它在预测未来、降低风险和利用新出现的机会方面起着至关重要的作用。
然而，这一过程正受到这些和其他需求驱动因素加速的严重影响。

　目前存在于这种波动、复杂和不确定环境中的企业正越来越多地被迫脱离传统的企业系统和控制——缓慢和孤立的运营以及遗留技术——以数字化其运营或允许价值的普遍损失在整个公司中继续。

　这份白皮书将研究机器学习(ML)和人工智能(AI)等下一代技术如何显著提高企业预测的准确性，确保企业生存和发展，而不是落后。

顾客永远是对的
消费者行为的变化

Feedvisor 的年度亚马逊客户行为报告调查了 2000 多名亚马逊购物者。其 2019 年的报告发现，85%的 18-32 岁消费者在网上购买产品，约 37%的人每天或几乎每天都购物。需求的转变仍在继续显著进化。

2022 年的报告指出，超过 57%的消费者表示，他们现在比疫情之前进行了更多的网上购物。28%的消费者表示预算是购买决策中最重要的因素，但 55%的亚马逊购物者表示他们经常购买
搜索结果后列出的第一个产品。25%的人表示方便是最重要的因素。

向电子商务零售的最大转变发生在 2020 年。随着 COVID 感染率的上升和下降，实体零售商开始关门，消费者变成了全渠道购物者，他们寻求有竞争力的价格和方便的送货选择。这使得利用历史数据或滞后需求指标来预测市场变化速度并做出反应变得非常困难。

对于许多使用传统预测方法的企业来说，结果是错失机会、更高的资本成本、过量库存、浪费和更大的产品过时或腐烂风险——这在快速发展的消费品 (CPG) 行业是一个相当大的风险。此外，疫情还提高了消费者对健康、保健和福祉与地球健康之间关系的认识。千禧一代目前是全球领先品牌的主要消费群体。与 Z 世代消费者一样，千禧一代是具有环保意识的消费者，他们愿意为可持续产品支付更多费用，Z 世代最愿意支付 73%，相比之下，千禧一代的支付比例为 68%。

人们期望品牌成为消费者和整个世界的形象大使，以透明的方式行事，经得起推敲。这反过来又给化学和制造业的公司带来压力，要求它们减少塑料产量，减少碳排放，并在 R&D 投资，以寻找产品的清洁替代品。

卓越的供应链和以客户为中心可以为跨行业的企业提供独特的优势，使他们在全球范围内脱颖而出

竞争。通过使用人工智能和人工智能等下一代技术改善预测，可以对各种场景进行建模，并捕捉和测量假设。这使得企业能够更好地服务

同时优化供应链成本、提高可见性和整合运营。因此，组织可以根据领先的需求指标，更加关注对市场潜力有共同看法的机会。这是一个新兴的、令人鼓舞的运营现实，符合消费者期望的新世界。

与 Z 世代消费者一样，千禧一代也是具有生态意识的消费者，他们愿意为可持续产品支付更多费用

切换到领先指标

对他们的预测采取传统立场的组织面临着一个现代的困境。传统的预测模型主要使用基于历史销售数据的时间序列技术。但需求的快速波动意味着企业需要将注意力从仅仅预测中长期规划范围内的未来预测水平，转移到更准确的短期规划。市场中有一个数据宝库，但有限的处理能力和使用历史数据预测任何特定时刻的供应链状况的根本局限性，无法理解所有这些。

数据方面的考虑正在快速发展。通过消费者人口统计、传统销售历史和宏观经济指标(如国内生产总值(GDP)和利率)获得的市场知识是预测的基础，但现在你可以添加来自自动化和边缘技术(如物联网)的实时智能数据的激增，以及从社交媒体、评论网站、竞争对手领域和新闻页面涌入的领先指标。
取决于行业和商业因素
例如当地天气、商店周围的事件、道路状况等等，都会影响客流量和交通流量，从而为数据添加更多的上下文元素。
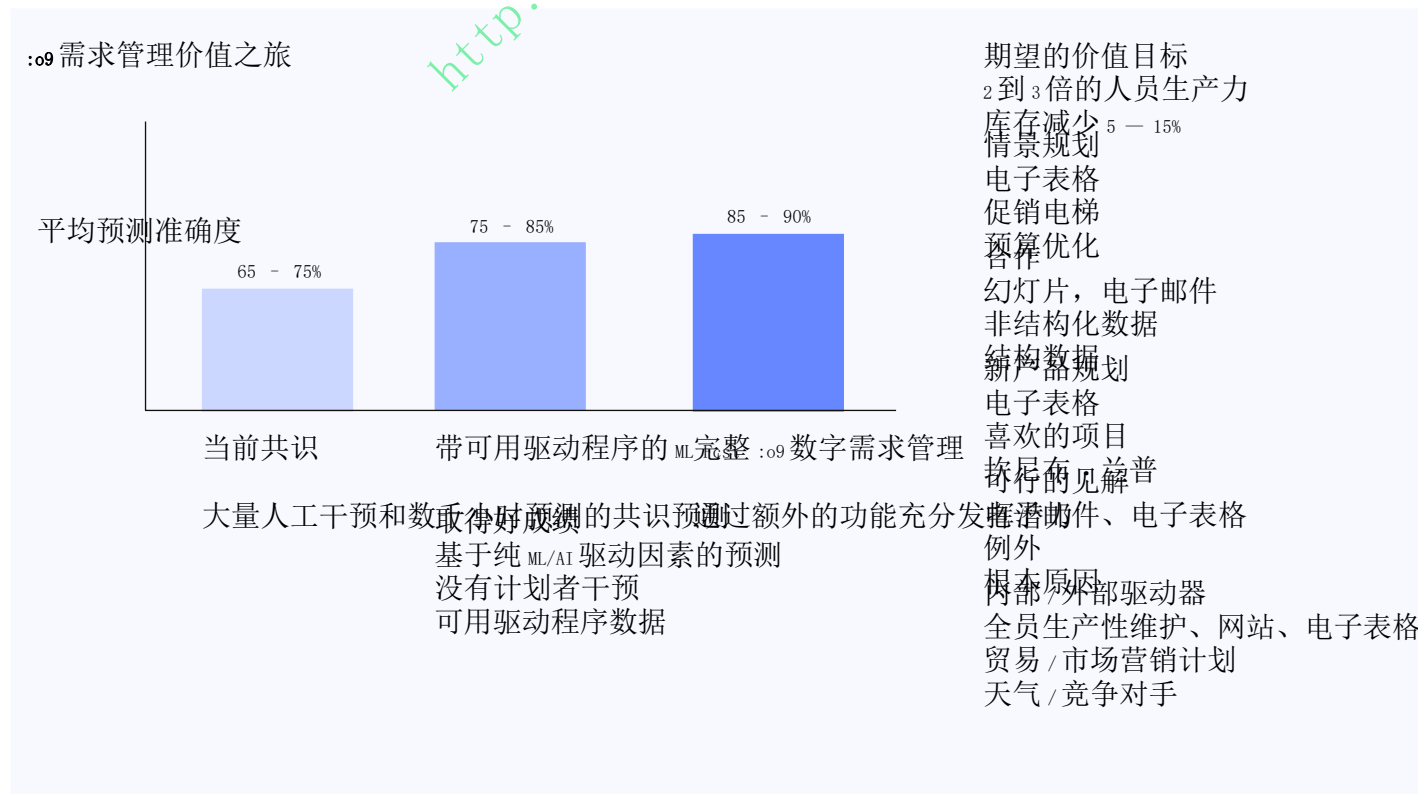
　　放弃时间序列预测，通过人工智能、人工智能和云计算进行智能预测，提供了强大的优势。这些下一代技术可以获取领先指标数据，并创建免费的预测视图
人为的偏见或操纵。同时不断了解什么样的领先指标数据最能预测变化，以实现更准确的预测，精确到位置、项目和时间等具体细节。

:o9 需求管理价值之旅

期望的价值目标
2 到 3 倍的人员生产力
库存减少 5 — 15%
情景规划
电子表格
促销电梯
预算优化
否

幻灯片，电子邮件
非结构化数据
结构数据划
电子表格
喜欢的项目
拔尾见解普
幻灯片、电子邮件、电子表格
例外
根本原因
内部 / 外部驱动器
全员生产性维护、网站、电子表格
贸易 / 市场营销计划
天气 / 竞争对手

平均预测准确度

65 — 75%　　　　75 — 85%　　　　85 — 90%

当前共识　　　带可用驱动程序的 ML 完整 :o9 数字需求管理

大量人工干预和数取样好成测的共识预测过额外的功能充分发挥潜时件、电子表格
基于纯 ML/AI 驱动因素的预测
没有计划者干预
可用驱动程序数据

学习 AI/ML 预测的步骤

为了从这些丰富的信息中做出任何有意义的推断，必须将数据转换为知识，以便更好地理解需求驱动因素和客户行为。然而，这项活动需要及时执行，以使企业能够利用内在的洞察力。那么，AI/ML 预测的步骤有哪些呢？

AI/ML 预测解决方案的第一步是数据识别、收集和协调过程。这是收集和准备使用源销售、属性、事件活动、假期、天气、互联网抓取和任何其他所需数据的地方。清理和协调包括识别和修复不正确的值，定位和替换缺失的元素，以及将数据应用到最合适的层次分组和数据流中。

第二步是数据分析和特征工程。这一阶段涉及探索性数据分析，其中测量数据的分布并研究相关性和相互作用。

这里执行分割以创建数据切片，然后解释数量、波动性和间歇性以及它们与产品生命周期和季节性等元素的关系。这是特征工程的阶段。创建、测试、改进和丢弃数据的特征、分组和聚类。最后，基于数据转换结果和领域知识进行驱动程序评估和选择。

第三步是模型迭代。在这里，将在预测过程中使用的算法方法被确定和维护。预测自动化有三种类型：统计、机器学习和深度学习。这些方法以及它们所使用的模型需要被测量以获得最合适的结果。这种评估应该在不同的数据层面和这些层面的不同层次上进行，以便确定最佳的模型、分段和层次组合。

最后一步是模型训练、验证和比赛。在这里，应该执行参数调整，并使用回溯测试、滑动和扩展时间窗口分析来训练模型，以进行交叉验证。定义误差度量，并进行比赛，以便找到性能最佳的算法"配方"。最后，这一步包括通过设置和应用护栏来管理任何业务/数据驱动的约束，从而对未来预测进行微调。

了解人工智能/人工智能预测自动化的类型

如前一节所述，AI/ ML 预测生成的三种类型是统计、机器学习和深度学习。统计通常是指"经典"的时间序列方法，如移动平均和指数平滑法，这些方法使用历史销售数据来生成预测。较新的广义加性模型 (GAM) 如 Prophet 使用历史销售额和节假日作为源数据，尽管它们与经典时间序列有更多的共同点，但它们可以被视为走向第二种预测生成方法的第一步:ML 预测。

　　像 Prophet 这样的 GAM 模型可以进行调整，以包括假期以外的其他因果因素，如一周的促销次数，使它们成为基于 ML 预测算法的入门级驱动程序的理想选择。在决策树中，AI/ML 方法变得更加复杂，能够处理多种数据驱动输入，如事件类型、价格折扣和规模，以及一周内的历史销售、假期和促销。梯度增强决策树使用集成模型和多种算法一起创建最终预测。

第三种 AI/ML 方法是深度学习，其中 AI/ML 解决方案自动执行数据分析和特征创建。这种解决方案是非常数据密集和耗时的，但是它在减少特征工程的人工努力方面具有优势。深度学习解决方案最初可以从使用"实体嵌入"的梯度增强决策树中开发，这将限制正在分析的数据。神经基础扩展分析是针对历史销售数据的最先进的深度学习解决方案。

介绍：o9 的数字大脑
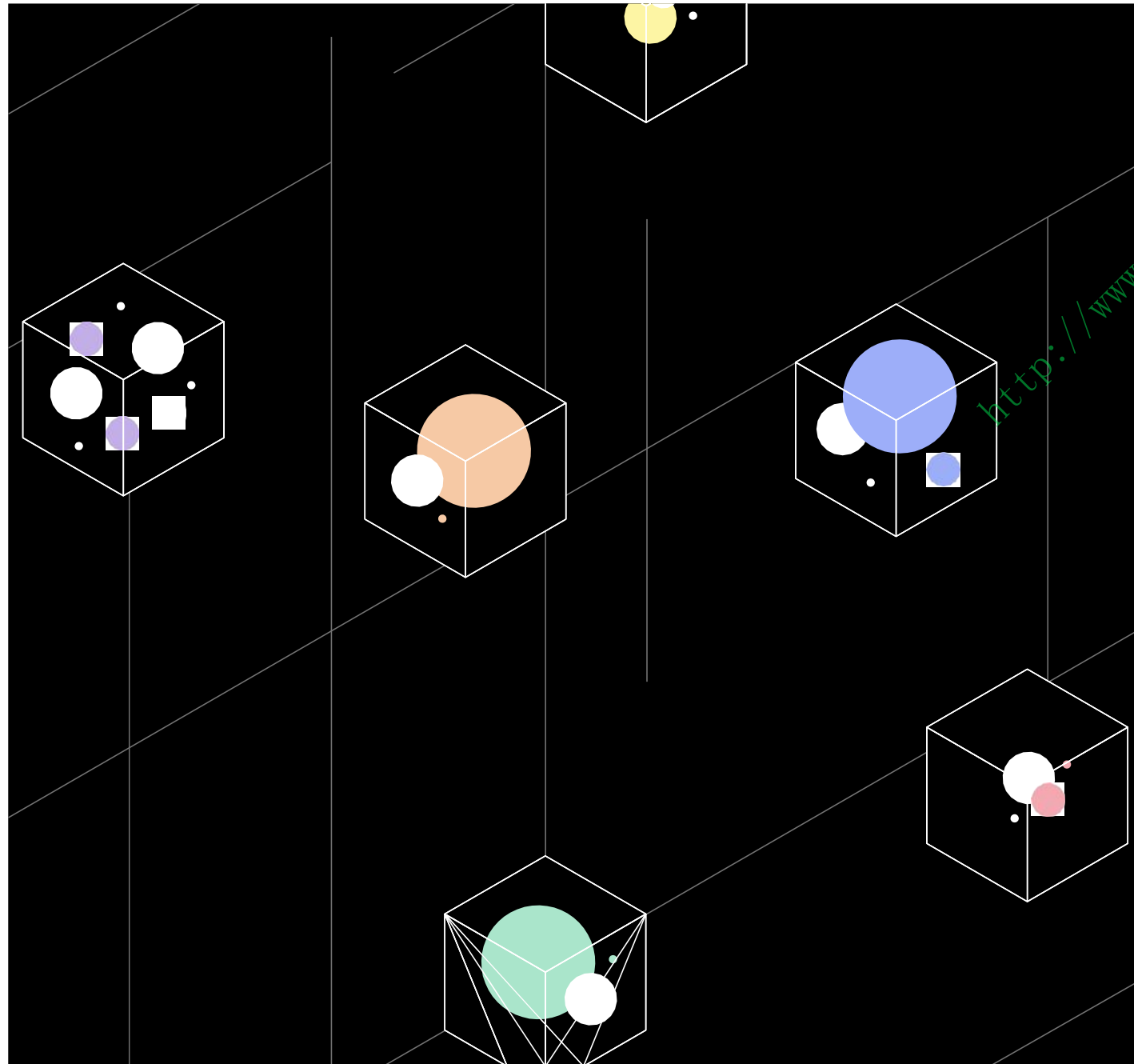
面对上述所有的不确定性、复杂性和波动性，下一代平台，如：o9 的数字大脑，正在帮助企业以一种积极和无畏的方式与时代接轨。

它通过自动化增强人类智能来做到这一点。这个集成的云原生平台使用人工智能和人工智能来推动协作性的数据驱动型决策。通过汇集孤立的和外部的市场数据，数字大脑允许公司获得实时的洞察力，帮助他们更好地规划，做出更好的决策，并连接他们组织的点。

:o9 的数字大脑能力

→敏捷发展:建模灵活性

预测时，系统灵活性和可扩展性是一项关键能力。以全球制造公司为例，这些公司拥有庞大而多样的产品组合，通过零售、直销、在线和分销进行销售。他们的产品组合对需求驱动因素很敏感，如季节性、促销、定价、生命周期日期等等。现代规划解决方案不应该简单地为变化做准备，它们应该支持和促进变化。数字大脑是一个集成系统，由取代传统电子表格的构建模块的功能组成，同时有效地模拟业务的粒度和变化。

→ AI/ML 预测:从无代码机器学习到深度学习

通过无缝地从基于经典统计规则的最佳拟合公式预测，到使用 o9 的 AI.predict 插件的无代码入门级 ML 预测，再到深度学习神经网络决策树，管理预测成熟度增长。:o9 AI/ML 预测功能包括特征工程、巡回赛和集成预测以及细分、销售和销售预测创建、驱动因素可解释性自动异常值校正、情景规划、生命周期管理和互动统计预测。

　　:o9 为平台 AI/ML workbench 使用标准 Python、R 和 Jupyter note-book。可插拔架构设计用于托管外部算法、解算器和模型。与外部 ML Ops 管道的接口允许外部训练的模型直接在:o9 平台上运行，并且这些模型受益于与数据点实体的直接交互以及与:o9 内存数据存储中的图形立方体。导入的模型可以大规模运行，利用 :o9 的 Hadoop Hive PySpark 集群环境。

→面向未来的定位:实时洞察

为了更快地发现风险和机会，以便有效地利用它们，实时可见性是必不可少的，尤其是在销售方面。销售团队对新产品、营销和促销计划、供应状况以及客户和竞争对手情报的了解占上风。在传统的组织中，这些信息分散在不同的部门，在多个不同的电子表格，在不同的粒度级别，跨越多个层面，带有内部偏见，完全依赖手动输入和更新。借助数字大脑，销售团队可以随时获得实时可见性，帮助他们销售更多产品，并更准确地进行预测。无缝收集、创建和管理销售机会信息、促销和营销活动，并将它们合并到共识计划中。

→取悦大众:快速需求和供应方案规划

数字大脑让企业能够满怀信心地应对需求的起伏。智能预测不仅仅是帮助计划者创建更准确的概率需求计划。对需求因素的更深入理解和 AI/ML 驱动的预测的学习能力使得许多需求计划能够自动化。智能预测解决方案可以创建反映当前和预期未来市场的制造和库存计划，

以及公司策略和约束，以解放计划者来处理异常和不可预测的中断。情景规划能力允许多种选择的未来进行设想、比较和考虑以达成共识。自动化智能预测产生的计划优化程度是人工或传统解决方案无法实现的。

→ "三 A" 能力:警报、分析和假设

准备是关键。为了避免预测盲点，数字大脑使用智能警报来通知销售团队成员和支持计划员上一个周期的变化。这使得能够对计划和基于场景的响应进行动态调整，这在必须遵循严格的合规性和产品监管流程的行业中是一项关键功能(例如化学和食品)。该系统还使用人工智能分析来创建基线预测，作为销售团队审查的起点。人工智能解决方案还可以提供强大的预测假设，帮助销售团队提供他们关于预测为什么会发生变化的知识。假设的可见性有助于减少甚至消除其他函数对预测的二次猜测。

→弥合孤岛:倡议、协作、规划和执行

顾名思义,消除差距就是消除预测和计划之间的差距。在销售团队与客户一起推动各种定价和促销活动的情况下,当需要支持时,需要将风险和机会传达给组织的其他部分。数字大脑支持跨职能协作,使销售团队能够快速、主动地构思、协作、创建、规划和执行计划。:o9 的平台还允许与供应商和原始设备制造商进行实时协作,确保预测、库存和数据可以无缝共享。管理风险和机会以感知和塑造需求。

→磨练表现:赛后分析

该系统应便于销售管理人员评估实际绩效、预测和原始计划,并评估个人和团队对风险和机会的反应是否足够快。这将有助于推动销售组织的问责制和持续改进,并有助于创造基于相对排行榜和基准的健康竞争文化。

→简单易行:直观的用户界面

数字大脑是为直观使用而设计的,理解该平台必须由计划者、管理者和团队的一线成员使用。这划分了所需的可用性级别。管理人员可以对照计划查看绩效报告,召开在线会议,并与组织合作实施差距缩小计划。销售人员和一线角色可以通过他们的移动设备随时查看见解并提供意见。

→构建模块:开放标准和开放架构

:o9 构建在一个统一的数据模型上。从功能上来说,所有组件都可以访问平台上的所有数据。企业知识图(EKG)是驱动该平台的"数字大脑",它建立在获得专利的内存优化图立方体数据库上。正如:o9 支持开放标准和开放架构原则,"数字大脑"由一套全面的开源堆栈支持,包括 Apache Hadoop、Nifi、Spark 和 Kafka。这些开放标准堆栈确保了与外部数据源的兼容性、与客户架构的一致性以及对接口的适应性。

o9 平台整合了一个全面的系统 API 层,确保 EKG"数字大脑"和开源堆栈之间的通信和无缝连接,提供集成、数据升级和清理、定制开发和其他功能。:o9 的模块化架构支持 Python 和 R 插件以及 Gurobi 和 Operaize 等第三方优化器和解算器。该平台集成了完整的 Python 和 R 环境,允许从基于 Tensorflow、Keras 或 PyTorch 构建的 AI/ML 模型直接编程访问 EKG。

结论

数字大脑强大的自动化和分析功能使跨职能部门能够洞察当前和预期的未来市场，以及企业战略和约束。

o9 平台的设计目的不仅仅是帮助规划者努力创建更准确的概率需求计划，而是在一个知识模型中使用统计、因果和计量经济学数据，使公司能够利用定量和定性数据。在商业方面，公司必须围绕如何推动计划做出的决策，无论是新产品，还是营销或定价，都是在递增的投资回报率水平上做出的。有了这种关于驱动需求的数据和洞察力，o9 可以驱动决策，超越基于部落和历史知识的决策，并利用机构和市场知识。:o9 提供同类最佳的预测准确性，使

规划者拥有单一的事实来源，他们可以在同一时间左右预测，为企业提供灵活性和弹性，以减轻不断变化的需求波动。

波动是新常态。无论是天气条件、定价还是库存问题，供应链中断都会出现，导致计划者调整预测以反映新的情况。一个组织的历史数据不再足以创建准确、可靠的预测。人工智能/人工智能技术能够引入大量的外部数据，对其进行净化和协调，以产生有价值的见解，直接应用于您的预测。

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内容和编辑西蒙·乔伊纳
产品管理总监
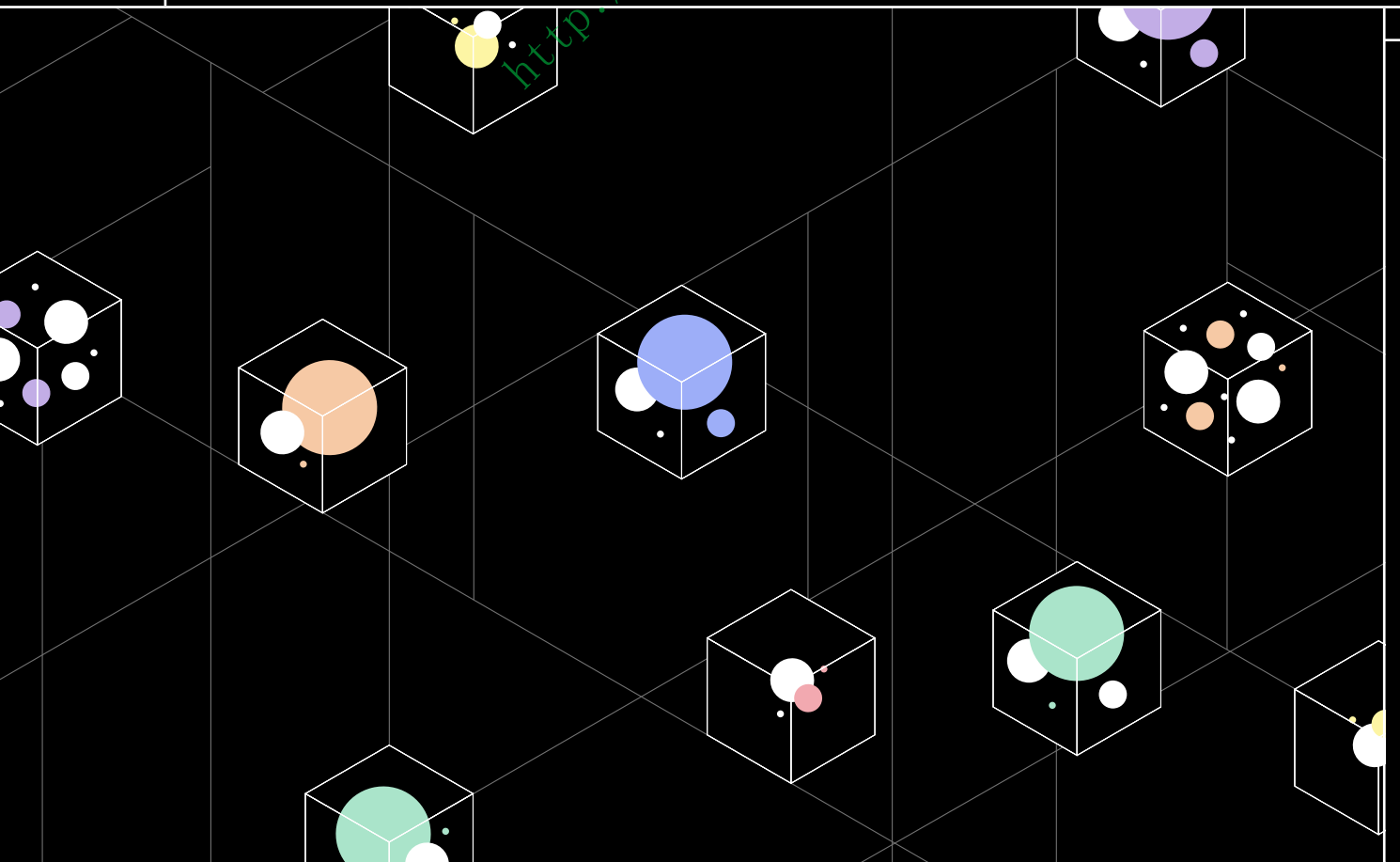simon.joiner@o9solutions.
com 连接→

设计:o9 设计实验室

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AI-Powered Demand
Forecasting
## Future-ready thinking
with o9's Digital Brain

- Whitepaper

Introduction

Supply chains today are being buffeted by change. Consumers are demanding the best product selection at competitive prices, along with rapid delivery and customizability options.

All while the world faces uncertainties brought about by climate change, trade tensions, resource scarcity, polarized politics, cyberattacks, COVID, conflict in Europe, the resulting fuel and food crisis, inflation, and fears of recession.

Legend: —— Historical Actuals – – Statistical Forecast ···· Forecast with COVID correction
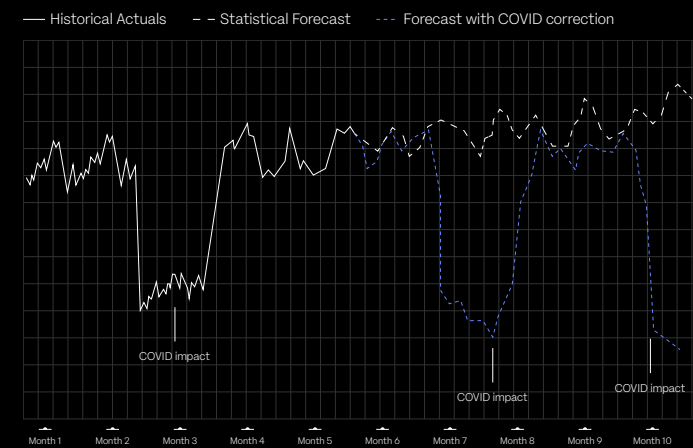
Forecasting, the lifeblood of an organization, has the critical role of being able to predict the future, mitigate risks, and capitalize on emerging opportunities. However, this process is being heavily impacted by the acceleration of these and other demand drivers.

Businesses that currently exist in this fluctuating, complex, and ambiguous environment are increasingly being forced to break from traditional enterprise systems and controls—slow and siloed operations and legacy technology—to digitize their operations or allow a pervasive loss of value to continue throughout the company.

This whitepaper will examine how next-generation technologies such as machine learning (ML) and artificial intelligence (AI) can significantly increase the accuracy of a business' forecast, ensuring it survives and thrives instead of being left behind.

The customer is always right
Changes in consumer behavior

Feedvisor's annual **Amazon Customer Behavior Report** polls over 2,000 Amazon shoppers. Its 2019 report found that **85% consumers between 18-32 buy products online,** with around **37% making a purchase either daily or almost daily.** The shift in demand continues to evolve significantly.

The 2022 report advises that **over 57% of consumers** say that they do **more online shopping now than prior to the pandemic.** 28% of consumers indicated that budget was the most important factor in purchasing decisions yet **55% of Amazon shoppers** reported that they **frequently buy the first product listed after search results**. 25% said that convenience is the most important factor.

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The biggest shift towards E-commerce retailing occurred in 2020. Physical retailers opened and closed their doors with spikes and lulls in COVID infection rates, consumers turned into omnichannel shoppers looking for competitive pricing and convenient delivery options. This made **forecasting using historical data, or lagging indicators of demand, to predict and react to speed of market changes hugely problematic.**

For many businesses using traditional forecasting methods, the result was missed opportunities, higher capital costs, excess inventory, waste and a greater risk of obsolescence or perished products—a considerable risk in the rapidly moving consumer packaged goods (CPG) industry. Additionally, **the pandemic has also enhanced consumer awareness of the relationship between wellness, healthcare and wellbeing and the health of the planet.** Millennials currently dominate as the consumer demographic for leading brands around the world. Along with Gen-Z consumers, Millennials are eco-conscious consumers who are willing to pay more for sustainable products, Generation Z is the most willing at 73%, compared to Millennials at 68%.

There is an expectation for brands to become ambassadors for their consumers and the world at large, acting in a transparent way that can withstand scrutiny. This in turn **puts pressure on companies in the chemical and manufacturing industry to reduce their plastic output, decarbonize and invest in R&D to find clean alternatives to products.**

Supply chain excellence and customer centricity can provide businesses across industries with a distinct advantage, differentiating them from global competition. **By improving forecasts using next-generation technologies such as AI and ML, various scenarios can be modeled and assumptions captured and measured.** This allows businesses to better serve customers and consumers whilst also optimizing supply chain costs, improving visibility and consolidating operations. Consequently, organizations can concentrate more on opportunities with a common view of market potential based on leading indicators of demand. This is an emergent and encouraging operational reality that matches the new world of consumer expectation.

Along with Gen-Z consumers, Millennials are eco-conscious consumers who are willing to pay more for sustainable products

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Switch to leading indicators

Organizations taking a traditional stance to their forecasting face a modern quandary. **Traditional forecasting models predominantly use time series techniques based on historical sales data.** But rapidly fluctuating demand means that companies need to shift their focus from solely predicting future forecast levels in mid- and long-term planning horizons, to more accurate short-term planning. There is a **treasure trove of data in the market, yet limited processing power and fundamental limitations in using historical data** to predict supply chain conditions at any specific moment, fails to make sense of it all.

Data considerations are fast-evolving. Market knowledge through consumer demographics, traditional sales histories and macroeconomic indicators such as Gross Domestic Product (GDP) and interest rates are the foundation of a forecast, but now you can add to this the proliferation of real-time smart data from automation and edge technologies such as the Internet of Things (IoT) and leading indicators flooding in from social media, review sites, competitor domains, and news pages. **Depending on the industry and business, factors such as local weather, events around the stores, road conditions, and more, at a zip code level, affect footfall and traffic add yet more contextual elements to data.**
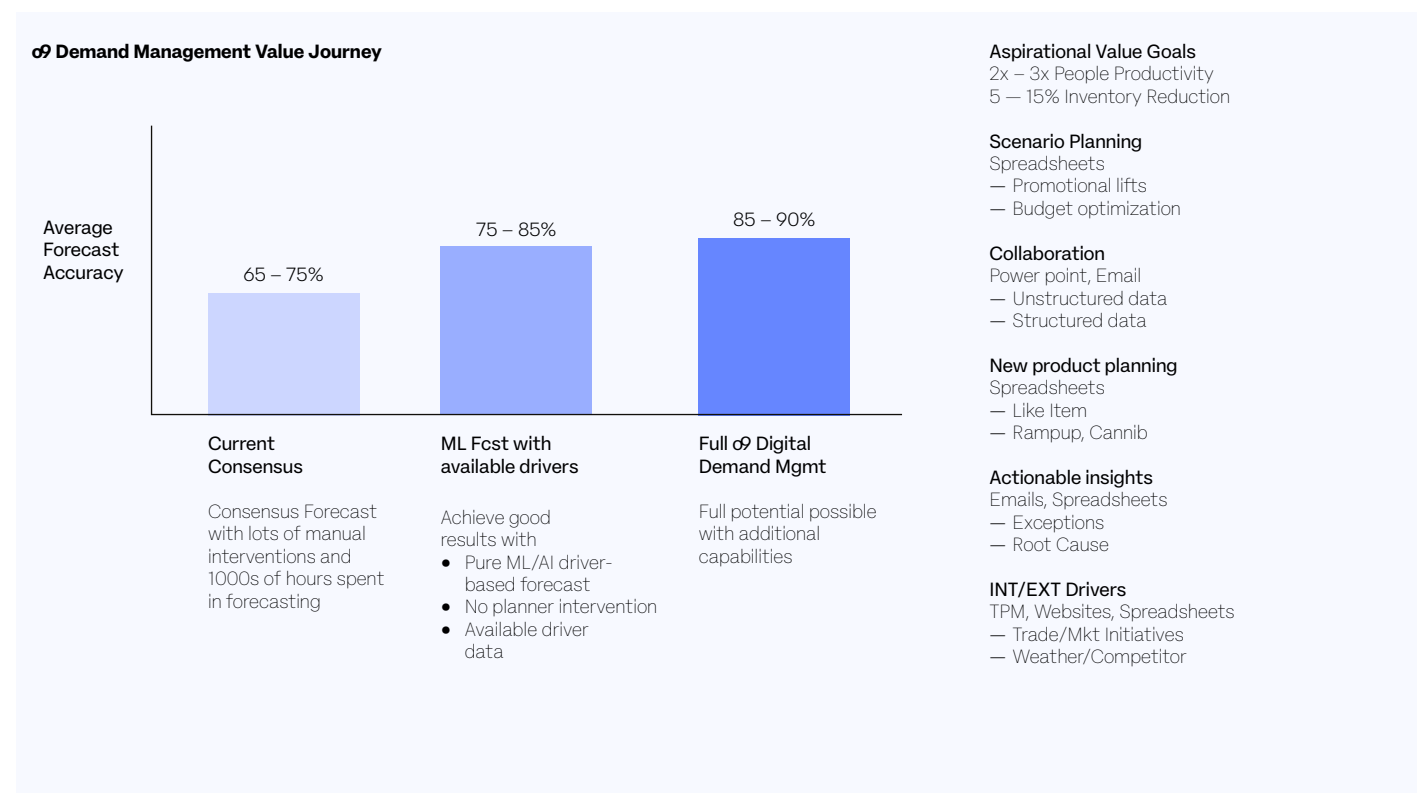
Dispensing with time series forecasting and embracing intelligent forecasting through AI, ML and cloud computing provides a powerful advantage. These next-generation technologies **can take leading indicator data and create a view of the forecast that is free of human bias or manipulation.** All while constantly learning what leading indicator data best predicts change for a more accurate forecast, right down to the granular detail, such as location, item and time.

o9 Demand Management Value Journey

Average Forecast Accuracy

65 – 75%	75 – 85%	85 – 90%

Current Consensus

Consensus Forecast with lots of manual interventions and 1000s of hours spent in forecasting

ML Fcst with available drivers

Achieve good results with
- Pure ML/AI driver-based forecast
- No planner intervention
- Available driver data

Full o9 Digital Demand Mgmt

Full potential possible with additional capabilities

Aspirational Value Goals
2x – 3x People Productivity
5 — 15% Inventory Reduction

Scenario Planning
Spreadsheets
— Promotional lifts
— Budget optimization

Collaboration
Power point, Email
— Unstructured data
— Structured data

New product planning
Spreadsheets
— Like Item
— Rampup, Cannib

Actionable insights
Emails, Spreadsheets
— Exceptions
— Root Cause

INT/EXT Drivers
TPM, Websites, Spreadsheets
— Trade/Mkt Initiatives
— Weather/Competitor

Learn the steps of AI/ML forecasting

To make any meaningful inferences from this wealth of information, **data has to be converted into knowledge to better understand demand drivers and customer behavior.** However, this activity needs to be performed in a timely manner to enable a business to capitalize on the insights inherent within. So, what are the steps of AI/ML forecasting?

The first step for an AI/ML Forecasting solution is the process of data identification, collection and harmonization. This is where source sales, attributes, event activities, holidays, weather, internet scraping and any other required pieces of data are collected and prepared for use. Cleansing and harmonization involves the tasks of identifying and fixing incorrect values, locating and replacing missing elements, and applying the data into the most appropriate hierarchy groupings and data streams.

The second step is data analysis and feature engineering. This stage involves exploratory data analysis where the distribution of data is measured and correlations and interactions are researched.

Segmentation is performed here to create slices of data and then interpret the volume, volatility and intermittency and their relationship to elements like product life cycle and seasonality. This is the stage of feature engineering. Creating, testing, improving and discarding features, groupings and clusters of data. Finally **the driver evaluation and selection is made based on data transformation results and domain knowledge.**

The third step is model iterations. Here the algorithmic methods to be used in the forecasting process are determined and maintained. There are three types of forecast automation: Statistical, Machine Learning and Deep Learning. These approaches, and the models that they use need to be measured for the most appropriate results. This assessment should be performed on different slices of data and at various levels in those slices in order to determine the best model, segment and level combinations.

The final step is model training, validation and tournamenting. Here, parameter tuning should be performed and the models trained with backtesting, sliding and expanding time window analysis for cross validation. **Error metrics are defined and tournaments are played in order to find the top performing algorithm 'recipes'.** Finally, this step involves the fine-tuning of future predictions by setting and applying guardrails to manage any business/data-driven constraints.

# Learn the types of AI/ML forecast automation

As noted in the previous section, the three types of AI/ML forecast generation are statistical, machine learning and deep learning. **Statistical usually refers to the 'classical' time series methods such as moving average and exponential smoothing that use historical sales data to generate a forecast.** Newer generalized additive models (GAM) such as Prophet use historical sales and holidays as source data and although they have more in common with classical time series they can be considered the first step towards the second forecast generation method: ML forecasting.

The GAM models like Prophet can be adapted to include additional causal factors beyond holidays such as the number of promotions in a week, making them ideal as entry-level driver based ML forecasting algorithms. **Decision trees are where the AI/ML methods become more sophisticated and capable of handling multiple data driver inputs such as event types, price discounts and sizes in addition to the historical sales, holidays and promotions in a week.** Gradient boosted decision trees use ensemble models with multiple algorithms working together to create the final forecast.

The third AI/ML methodology is deep learning which is where the AI/ML solution is automated to perform data analysis and feature creation. **This kind of solution is extremely data intensive and time consuming but it has advantages in reducing the manual effort of feature engineering.** Deep learning solutions can be initially developed from gradient boosted decision trees using 'entity embedding' which will limit the data being analyzed. Neural basis expansion analysis is the state of the art deep learning solution for historical sales data.

Introducing o9's Digital Brain
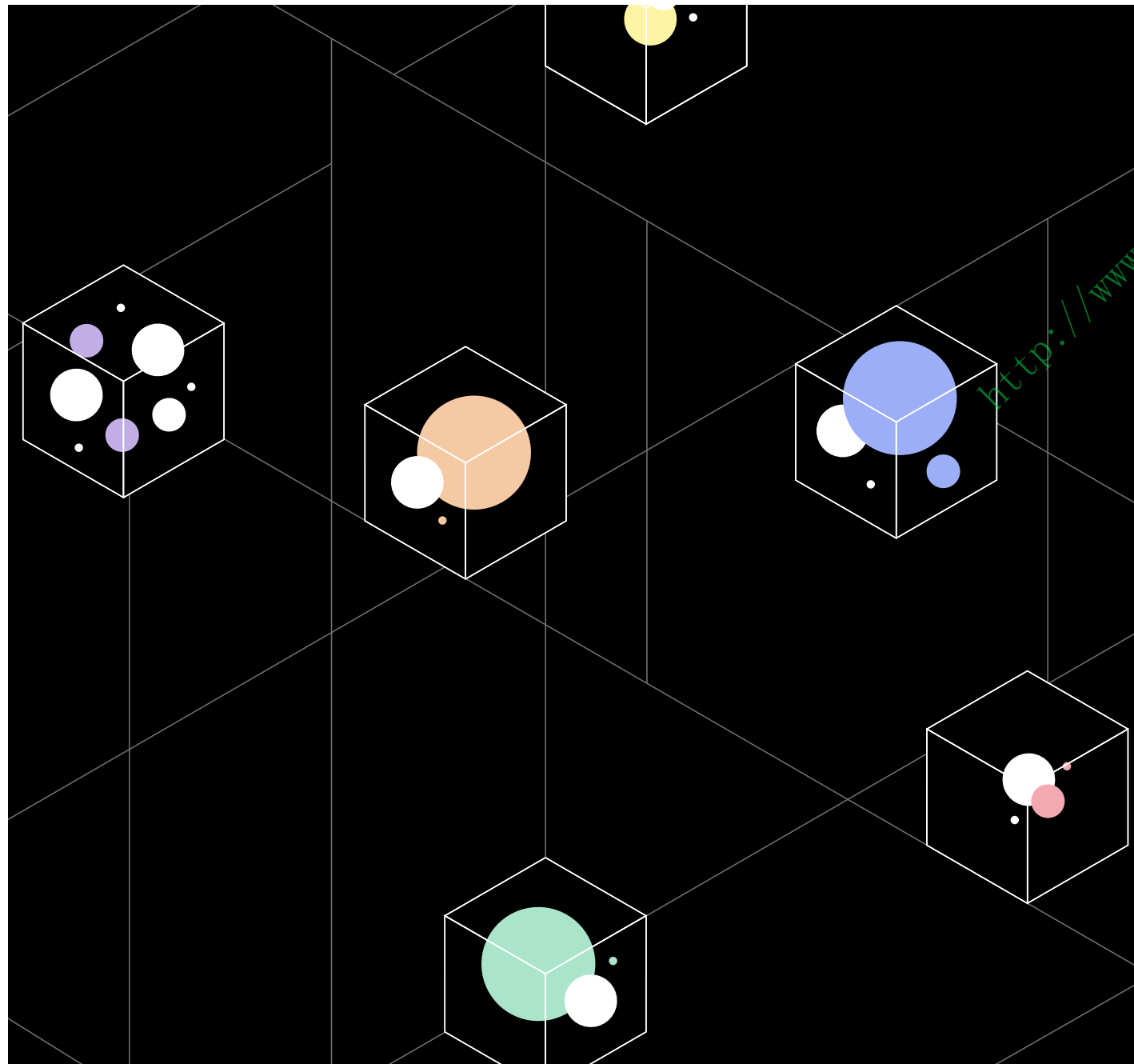
With all the uncertainty, complexity, and volatility described above, next-generation platforms such as o9's digital brain are helping businesses engage with the times in a proactive and fearless way.

It does this by augmenting human intelligence with automation. This integrated, cloud-native platform uses AI and ML to drive collaborative, data-driven decisions. By bringing together siloed and external market data, the digital brain allows companies to gain real-time insights, helping them plan better, make better decisions, and connect the dots of their organization.

o9's Digital Brain capabilities

→ **An agile evolution: Modeling flexibility**

System flexibility and extensibility is a critical capability when forecasting. Take global manufacturing companies as an example, with their large and varied product portfolio, sold through retail, direct sales, online and distribution. Their portfolio is sensitive to demand drivers such as seasonality, promotions, pricing, lifecycle dates—the list goes on. **Modern planning solutions shouldn't simply be prepared for change, they should enable and facilitate change.** The digital brain is an integrated system made up from capabilities in building blocks that supplant traditional spreadsheets while effectively modeling the granularities and variations of a business.

→ **AI/ML Forecasting: From no-code machine learning to deep learning**

Manage forecasting maturity growth by seamlessly moving from **classical statistical rules based forecasting with best fit formulas, through to no-code entry-level ML forecasting with o9's AI.predict plugin, and onto deep-learning neural network decision trees.** o9 AI/ML forecasting capability includes feature engineering, tournamenting and ensemble forecasting along with segmentation, sell out and sell in forecast creation, driver explainability automated outlier correction, scenario planning, lifecycle management and interactive statistical forecasting.

o9 uses standard Python, R and Jupyter notebooks for the platform AI/ML workbench. The pluggable architecture is designed to host external algorithms, solvers and models. **Interfacing with external ML Ops pipelines allows externally trained models to run directly on the o9 platform and these models benefit from direct interaction with data points entities and relationships with the o9 graph-cube in memory data store.** Imported models can be run at scale leveraging o9's Hadoop Hive PySpark cluster environment.

→ **Future-ready positioning: Real-time insights**

To spot risks and opportunities sooner in order to capitalize on them effectively, real-time visibility is essential, especially when it comes to sales. **Sales teams with insights into new product, marketing and promotion initiatives, supply status and customer and competitor intelligence gain an upper hand.** In traditional organizations, this information is dispersed across different departments, collated in multiple, disparate spreadsheets, at different levels of granularity, across multiple horizons, laced with internal bias and fully dependent on manual input and updates. With a digital brain, real-time visibility is readily available to sales teams, helping them sell more and forecast with greater accuracy. Seamlessly collect, create and manage sales opportunity information, promotional and marketing activities and merge them into the consensus plan.

→ **Crowd pleasing: Rapid demand and supply scenario planning**

The digital brain allows businesses to meet falls and surges in demand with confidence. Intelligent forecasting goes beyond assisting planners in creating more accurate probabilistic demand plans. **The deeper understanding of demand factors and the learning abilities of AI/ML-driven forecasting enable automation of many demand plans.** The intelligent forecasting solution can create manufacturing and inventory plans that reflect the current and expected future market,

as well as corporate strategies and constraints, to free up planners to address exceptions and unpredictable disruptions. Scenario planning capability allows multiple alternative futures to be envisioned, compared and considered for consensus. The automated intelligent forecasts produce plans optimized to a degree not possible either manually or with traditional solutions.

→ **"Triple A" power: Alerts, analytics, and assumptions**

Preparation is key. To avoid forecasting blind spots, the digital brain uses smart alerts to notify members of sales teams and supporting planners of changes from the last cycle. This enables dynamic adjustments to be made to plans and scenario-based responses—**a critical capability in industries that have to follow stringent compliance and product regulatory processes** (e.g. chemical and food). The system also uses AI-powered analytics to create a baseline forecast as a starting point for the sales team to review. AI-powered solutions can also provide strong forecast assumptions that help the sales teams provide their knowledge of why the forecasts have changed. Visibility into assumptions helps reduce—even eliminate—second guessing of forecasts by other functions.

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→ Bridging silos: Initiatives, collaboration, planning and execution

Gap closure is, as its name suggests, the literal act of closing the gaps between forecasts and the plan. Where sales teams drive a variety of pricing and promotion initiatives with customers, risks and opportunities need to be communicated to other parts of the organization when support is required. **The digital brain allows cross-functional collaboration, empowering sales teams to ideate, collaborate, create, plan and execute initiatives rapidly and proactively.** o9's platform also allows real-time collaboration with suppliers and OEMs, ensuring forecasts, inventory and data can be seamlessly shared. Manage risk and opportunities to sense and shape demand.

→ Honing performance: Post-game analytics

The system should make it easy for sales management to evaluate actual performance vs. forecast vs. original plan and to assess if the individuals and teams responded to risks and opportunities fast enough. This will help drive accountability and continuous improvement in the sales organization and **help create a culture of healthy competition based on relative leaderboards and benchmarks.**

→ Easy does it: Intuitive UI

The digital brain has been designed for intuitive use with the understanding that the platform must be used by planners, managers and frontline members of the team. This stratifies the level of usability that is needed. Managers can review reports on **performance versus the plan**, conduct online meetings, and collaborate with organizations on gap closure initiatives. And salespeople and frontline roles can view insights and provide input on the move, all through their mobile devices.

→ Building blocks: Open standards and open architecture

o9 is built on a single unified data model. Functionally all data across the platform is accessible to all components. The Enterprise Knowledge Graph (EKG), the 'digital brain' that drives the platform is built on a patented in-memory optimized Graph Cube database. As o9 supports open standards and open architecture principles, the 'digital brain' is supported **by a comprehensive set of open-source stacks** including Apache Hadoop, Nifi, Spark and Kafka. These open standards stacks ensure compvatibility with external data sources, alignment with customer architectures and adaptability to interfaces.

The o9 platform incorporates a comprehensive system **API layer which ensures communication and seamless connectivity** between the EKG 'digital brain' and the open-source stacks that provide integration, data staging and cleansing, custom development and other functions. o9's modular architecture supports Python and R plug-ins and third party optimizers and solvers such as Gurobi and Operaize. Full Python and R environments are incorporated within the platform allowing direct programmatic access to the EKG from AI/ML models built on Tensorflow, Keras or PyTorch.

Conclusion

The digital brain's powerful automation and analytics capabilities empower cross-functional departments with insights that reflect current and anticipated future markets, as well as corporate strategies and constraints.

The o9 platform has been designed to go beyond assisting planners in their efforts to create more accurate probabilistic demand plans, using statistical, causal, econometric data tied together in a knowledge model that allows companies **to leverage quantitative and qualitative data.** On the commercial side, decisions companies have to make around how to drive initiatives, whether it's a new product, or about marketing or pricing are prescribed at an incremental ROI level. With this kind of data and insight about what is driving demand, o9 can **drive decisions beyond** those being made on tribal and historical knowledge and use institutional and market knowledge. o9 offers best-in-class forecasting accuracy that empowers planners with a single source of truth they can forecast around and at the same time, offering businesses the agility and resilience to mitigate the changing landscape of demand volatility.

Volatility is the new normal. Whether it's weather conditions, pricing, or inventory issues, supply chain disruptions will emerge, causing planners to adjust forecasts to reflect new scenarios. **An organization's historical data is no longer enough to create an accurate, reliable forecast.** AI/ML technologies are able to bring in volumes of external data, cleanse, and harmonize it to create valuable insights that are directly applied to your forecast.

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Content and editors	**Simon Joiner**
	Director of Product Management
	simon.joiner@o9solutions.com
	Connect →
Design	o9 Design Lab