ARTIFICIAL INTELLIGENCE AND PROJECT MANAGEMENT

Project Management Institute Sweden

About PMI

PMI was founded in 1969 and is today the world's leading organization for people interested in project work and professional project management. PMI today represents over 600,000 members in 180 countries. It is a non-profit, politically and religiously unbound, whose purpose is to promote and develop project work and project management, disseminate information and create contact points for issues related to project work.

PMI Sweden Chapter

The PMI Sweden Chapter was founded in January 1998. We are a non-profit organization, chartered by the global PMI organization. PMI Sweden Chapter is driven entirely by volunteers, including the board.

We are geographically divided into four branches: North, East, West and South. These branches are run by local working groups who arrange locally adapted activities and offer local networks. For certain areas of interest, there is also the opportunity to participate in nationwide virtual networks.

Our aim is to inspire and engage people to make ideas become reality. We do this by arranging events such as seminars, network opportunities, congresses, but also by being a source of knowledge in Project, Program and Portfolio Management tools and techniques, news and trends.

PMI Sweden Chapter is known to be a dynamic organization consisting of holders of the Project Management Professional (PMP)® credential and project leaders aiming to become PMP® credential holders. PMI Sweden Chapter promotes development in project management with regards to education and businesses in Sweden.

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Authors

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Contributors

The PMI Sweden Chapter would like to express our gratitude and appreciation to all the following people and organizations for their contribution.

In 2021 PMI Sweden decided to investigate what implications Artificial Intelligence will have on project management and how potentially it will impact the project management role and way of working in projects. This initiative was postponed to 2022 due to the pandemic and has resulted in following:

Article "AI implications of project management and has the pandemic sped up the adoption?" published on www.pmi-se.org website in March 2022. Inspired by PMI Network article "Brain power", from 2019 (Parsi, 2019)

- Marly Nilsson, PMI Sweden, author of the article
- Geetha Gopal, Panasonic Asia Pacific, interviewed in article
- Bruno Rafael Santos, PMI Brazil, interviewed in article
- PMI United States, contribution to the material in the article.

Passion for Projects Congress in Gothenburg Sweden 23-24 May, 2022. Topic "Artificial Intelligence and Project Management"

- Katarina Strömberg, VP Marketing and Communications, program responsible Passion for Projects Congress, PMI Sweden
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- Thomas Larsson, VP Membership, PMI Sweden
- Jeremy Parker, VP Professional Development & IT, PMI Sweden
- Bruno Rafael Santos, Speaker, PMI Brazil
- Geetha Gopal, Speaker, Panasonic Asia Pacific
- Mattias Berglund, Nexer group, Panel discussion
- Fredrik Hofflander, AFRY X, Panel discussion
- Paolo Nardi, Mobile Heights, Panel discussion

Marketing partner Nexer group

- Marketing of the Congress and survey

Survey "Artificial Intelligence Impact on Project Management"

- Marly Nilsson, Bruno Rafel Santos, Geetha Gopal, Mattias Berglund, Fredrik Hofflander, Paolo Nardi and Niklas Angmyr, input and feedback to the survey questionnaire
- Nexer group, AFRY and Mobile Heights supporting posts about the survey in Social media

Report "Artificial Intelligence and Project Management"

- Bruno Rafael Santos, PMI Brazil, Analysis and author of the report
- Marly Nilsson, PMI Sweden, Analysis and author of the report
- Katarina Korenkova, PMI Sweden, Layout and design of the report

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Acknowledgments

PMI Sweden would like to acknowledge all the people who have made this initiative possible, all the fantastic volunteers and partners alike. Not to forget all the respondents mostly from the PMI member community who have taken their time to help us understand their view on AI, what they think about future developments and how PMI can support knowledge growth in AI. Thank you!

It has been very inspiring to see how an area of common interest and passion can bring so many people together; from PMI, the project management community and the corporate sector, not only in Sweden but also from Brazil, Singapore and the United States.

Side by side, we have been working together with the article, Passion for Project congress, the survey on AI and project management and the report.

PMI Sweden hopes that this project will inspire many more cross-border projects within the PMI international member network and bring people together, with the ambition of sharing knowledge, insights and experience.

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Foreword

We are living in a world that is changing faster and faster. In the Project Management profession it is now more important than ever to keep up with new tools to be able to perform and deliver our best. One technology that currently is talked a lot about is artificial intelligence, and we are seeing more and more applications of this technology. The PMI Sweden Chapter is therefore very proud to present the results of our survey "Artificial Intelligence and Project Management" in this report.

The respondents show a great interest in artificial intelligence and want to know more about the subject, which shows the importance of sharing information about the technology. PMI Sweden Chapter hopes that this report will be a stepping stone for the project management community in Sweden and beyond, to inspire people to seek knowledge and apply the technology.

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Executive Summary

AI is a technology available since the 1950s. All industries are eager for its applications and disruptive potential, although very few have managed to exploit it, and many have failed. Project Management is one such industry, a highly specialized profession that has been on a profound transformation since before the 2020's pandemic and now faces the challenge of many other professionals: whether or not to embrace AI.

This survey is part of the Passion for Projects initiative, set forward by PMI Sweden. It is composed of 18 questions about the impact of AI on project management and its state of the art among the sampled professionals. The survey does not include demographic questions, and was shared with PMI members at the Passion for Projects Congress, via newsletters and social media from May to June 2022.

Most respondents are from Sweden, and Europe and are somehow related to the PMI. Additionally, they are primarily predictive project management professionals, but many also have non-project-related roles. Major industries, such as software and infrastructure, are represented, but notable responses came from government, retail and healthcare professionals.

Most of our respondents consider themselves newcomers to the AI field and are enthusiastic to learn more about the technology. On the other hand, they are only slightly impressed with the potential of AI. A notable number of organizations are creating AI technologies themselves rather than acquiring them on the market. Likewise, most of the respondents see the AI-powered market as requiring more soft skills than hard skills from future professionals.

Project management professionals surveyed are keenly aware of the potential and demands of an AI-powered market and the need to re-skill or improve in this new area.

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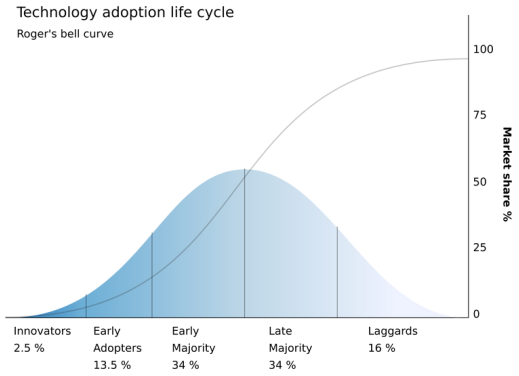
Introduction

According to a report from KPMG, "AI Transforming the Enterprise" (KPMG, 2019), organizations who have invested in AI report, on average, a 15% improvement in productivity. That should be eye-catching to companies who want to stay competitive and survive in a highly globalized world.

Artificial intelligence is not new technology as it has been known since 1956 when the term was coined by John McArthur. Despite having more than 60 years of availability, success has not come until recent years. The success has been enabled by: digitalization, a massive amount of available data, hardware advances, deep learning, business applications, and novel mathematical methods. Looking at the innovation adoption life-cycle (Exhibit 1), AI is in the early majority phase.

That we are in the early majority phase is supported by the responses in the survey. Very positive though, regardless of industry, experience and background, is that a majority of the respondents want to learn more about AI and believe that AI will have a measurable impact on the project management way of working, preventing the most common causes of project failure (Shaker, 2010).



This survey will give many interesting insights on what project management areas can be improved with help of AI, what skills will be required and much more.

Which ones can be solved by AI?

Planning and scheduling

The concept is old, as scheduling is very AI/ML friendly. Aytung et al (1994) has an interesting review on the subject and Juros et al (2022) shows a practical case application in supply chains. Neraas (2022) has direct applications on Project management by predicting delays in activities and combines IoT (internet of Things) and deep reinforcement learning for construction projects.

Lack of executive support

This is a human-human relation, a challenge for AI/ML models, but here, augmented intelligence comes to the rescue. Huhn et al. (2022) has shown some applications with Natural Language Processing (NLP).

Inexperience

In doubt? Ask the known-it-all deep learning model. There is a close relationship between AI/ML and knowledge management in organizations (Kai et Abbas, 2022). Liao (2003) mentions the use of data mining in knowledge discovery databases that can support inexperienced project managers and team members with advanced tasks.

Incomplete requirements

Another potential application of NLP, AI/ML and knowledge management. How about searching a database of thousands of projects for similar requirements and recommendations on requirements on a given project? Humanly impossible, but a simple task for deep learning models.

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Context and early recommendations

The survey objective is to look closely at how AI is applied in project management and whether the pandemic, likewise with other digital tools, have led to increased usage of it. This project is part of the Passion for Projects Congress, held in Sweden 2022, and as a follow up to the article Brain Power, originally published by the PM Network magazine in 2019 (Parsi, 2019).

AI, if properly used, can enhance and support the project manager's work and have a big impact on people-work relations. By augmenting the Project Manager, AI can lead to more efficient projects and also be a powerful factor in the competitive market before us.

Interviewing the same people from then, Bruno Rafael Santos, Data Scientist and working with knowledge management in PMI Rio de Janeiro Chapter, Brazil and Geetha Gopal, Head of Infrastructure Projects Delivery and Digital Transformation, Panasonic Asia Pacific, Singapore, we learned that things have evolved, but we are still just in the beginning of the early majority phase.

That we are in the early majority phase is supported by the responses in the survey. Very positive though, regardless of industry, experience and background. Many of the respondents have taken active measures to learn more about AI, everything from what's available for free on the internet to attending university or taking certification courses.

For more details read the article published by PMI Sweden: "AI implications on project management and has the pandemic sped up the adoption?" (**Nilsson, 2022**).

Recommendations yielded:

Recommendation 1

Regardless of where one is on the learning journey, we believe that PMI can play an important role in leading the project management community into the future by building a network of partners with the right qualifications with training and advisory service. Regarding online training, respondents thought that these should be free, but expressed a willingness to pay for face-to-face training.

Recommendation 2

Extracting value from Artificial Intelligence requires massive amounts of data in the right format and with good quality, which is paucity for most companies. With fast technological advancements, there are many first-time projects and previous experiences are just not there. For this reason, we suggest that PMI is the right organization to lead a data lake on project management related datasets.

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Purpose of the survey

The purpose of this survey was to investigate to what extent the PMI members and community think AI will impact the project management role, what future skills will be required from the project manager, the adoption and experience rate in companies and members, and in what areas and what kind of AI projects companies are investing in.

Methods

To get an overview of what the PMI members and PM community considers of AI we conducted a survey to explore the interest, knowledge, usage of AI in companies and if there are any interest to acquire AI knowledge through PMI and get support on their AI learning journey. This survey was conducted between 16th May – 30th June 2022 as part of an overall initiative by PMI Sweden which included a followup article of AI and project management "AI implications on Project Management and has the pandemic sped up the adoption" inspired by an article in PMINet 2019 "Brain Power", presentations and panel discussion by AI Experts on the Passion for Projects congress 23 -24 May 2022.

Since our focus was to understand where the PMI members are on the adoption life-cycle, we didn't ask demographic questions like gender, age, size of employers, number of years as project managers and so forth. Instead, we focused on questions like what impact they believe that AI will have in the next 3-years, what skills will be needed in the future and in what areas AI can make a difference to improve project outcome.

A couple of the questions were connected to the outcome from previous PMI Pulse of the Profession (PMI, 2019), like AI impact of project management the coming 3 years, areas that will be impacted and skills that will be required. Most of the questions had given alternatives with a couple of exceptions where it was important to get the respondent's opinion and experience.

Questions like; how they had acquired their knowledge and what kind of AI projects they had experience from and type of AI projects in planning. Due to the many surveys competing on people's time, the number of questions were rather few, 18 in total, with the goal that it should take the respondent maximum of 5-10 minutes to answer.

The survey was announced in the PMI Sweden newsletter one week before the congress, in the PMI Passion for Projects congress program, at the congress during the presentation about AI & Project Management and on several occasions in Social media. A reminder to answer the survey was sent one week before the 30th of June deadline. PMI's marketing partner in the 'AI and Project Management' program marketed the event including the survey to clients with a pronounced interest in new technology and project management. The survey was open between 16th May until 30th June and gathered 142 answers.

It is important to note that most questions are objective (a closed list of options) and allow for more than one answer at a time, that are not mutually exclusive. This leads to some graphs and tables in this analysis to sum-up to more than 100%.

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Results

Who are respondents?

Most respondents (close to 70%) heard about the survey from the PMI Sweden and Passion for Projects Congress website, at the congress, from the newsletter and posts on Social Media (Exhibit 2).

Since PMI Sweden was the major promoter of the survey, a majority of the respondents, 91,6%, were from Sweden/Europe (Exhibit 3).

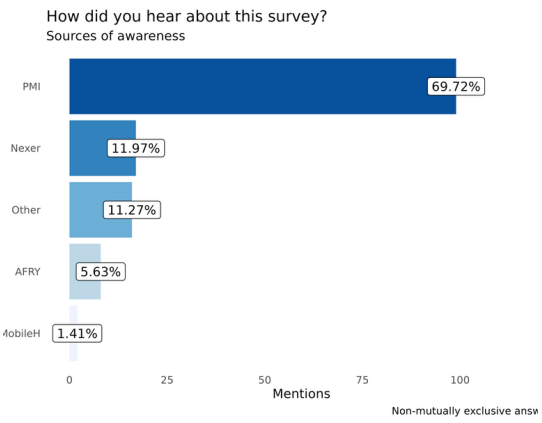


Exhibit 2

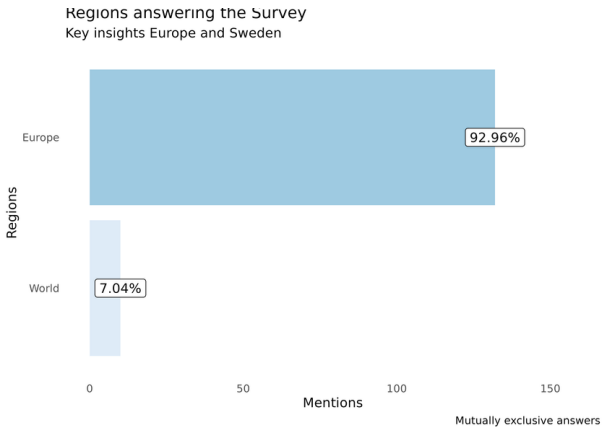
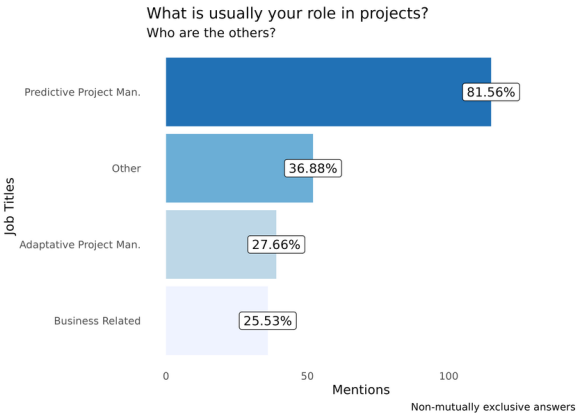


Exhibit 3

Roles, industries and Experiences

Most of our respondents are Project Managers (Exhibit 4), but project management is plural, so some of them are predictive practitioners (81,56%) and some are adaptive practitioners (27,66%). Notably, nearly 25% of them also have non-project management related roles (like Software Testing, Business Analysis and Change Management), suggesting the Project Economy (project team and business people) is also represented in the sample (Exhibit 5).



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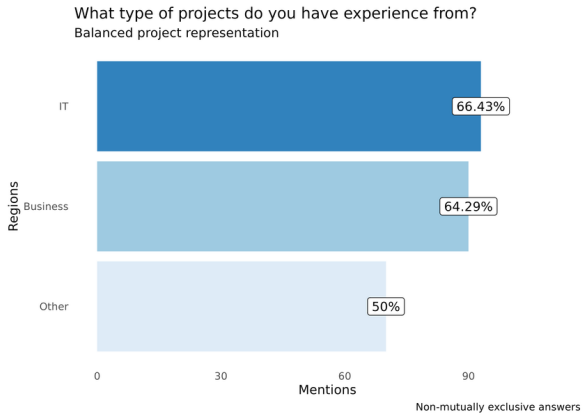

Exhibit 5

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This is interesting as predictive project management is still strong in most industries even though the widespread use of Agile, SAFe (Scaled Agile Framework) and DA (Disciplined Agile) would suggest the contrary. We are going to see this in detail later, as some industries which are known for predictive practices like construction, infrastructure and industrial applications are very well represented in the sample. Also, the presence of Business Related roles suggests the decision makers are also represented.

Regarding projects and industries, most of our practitioners are from IT-related projects (66,43%), traditional users of both adaptive and predictive practices whereas 64,29% of them have business-related projects (non-IT projects). Additionally, 50% of them also have other non-business and non-project related experience which range from business analysis to research and development.

This gives rise to a new question: which industries are represented? Well, most of them are Software and IT related (51,41%), followed by Infrastructure and Facilities (Construction, Energy and Telecom). Also, we have representatives from Education (Gov. and Education), and Chemistry (Industrial: Chemicals, Automotive).

A notable presence is from Health-related industries (Medtech, Life Sciences and Pharma) which are heavy users of R&D practices and one of the hottest frontiers in Artificial Intelligence applications (Exhibit 6). AI, by the way, is very well represented here. Software and IT are the developers needed for AI creation; Infrastructure and Facilities are both exploring and exploiting AI (Ruiz et al., 2020; Kahlil et al., 2022), while Financial Services and Retail (Other) have been heavy AI users for a long time now (Fehling et al., 2022).

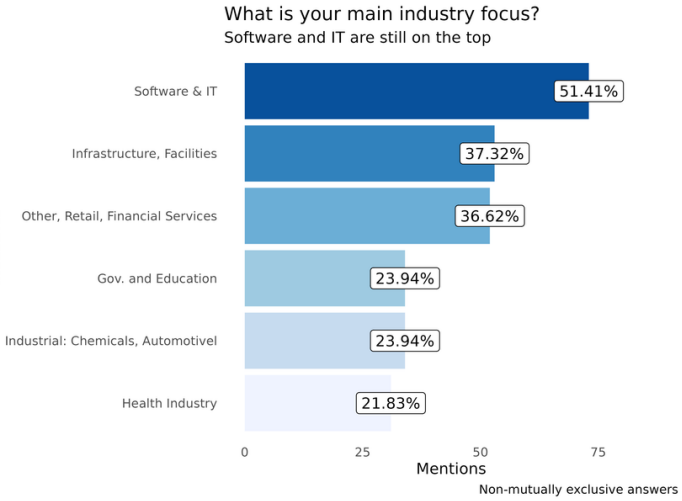

Exhibit 6

AI maturity among the respondents

Most of the respondents (74%) have just started or have limited knowledge in Artificial Intelligence, the remaining 26% have good or proficient knowledge (Exhibit 7). That matches closely the statistics on adoption rate in PMI Global Megatrends report 2022. Also, it suggests that the AI journey for project managers is in its infancy. If we wish project management to mass adopt AI technologies we also need to accelerate the data literacy among project managers.

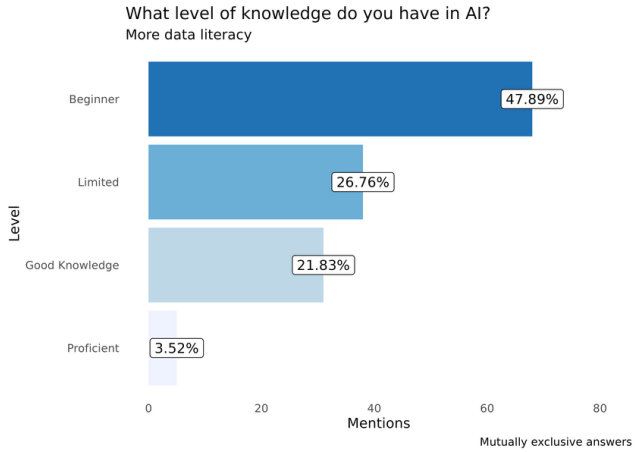

Exhibit 7

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A Good insight is that the majority wanted to learn more about AI (78%) very few (2,11%) were not interested at all (Exhibit 8). Market demand for AI in project management exists, and a qualification demand from project managers to learn about AI exists: how to connect them?

We have also asked our respondents about how they have acquired their knowledge on AI and data science. Some examples are summarized in Exhibit 9.

We can emphasize some of them:

- Online Courses and Seminars;
- Academic courses and university studies;
- Workshops and hands-on training with AI experts.

A majority of the respondents (71,83%) have never worked on an AI project, compatible with most of them being beginners and or having limited proficiency (Exhibit 10). A question still unanswered is "Have you been using AI in Project Management or have you been developing AI for Project Managers?". Since domain knowledge is relevant to AI development, we should ask ourselves where the AI solutions in project management are coming from project managers themselves. Well, we have the answer!

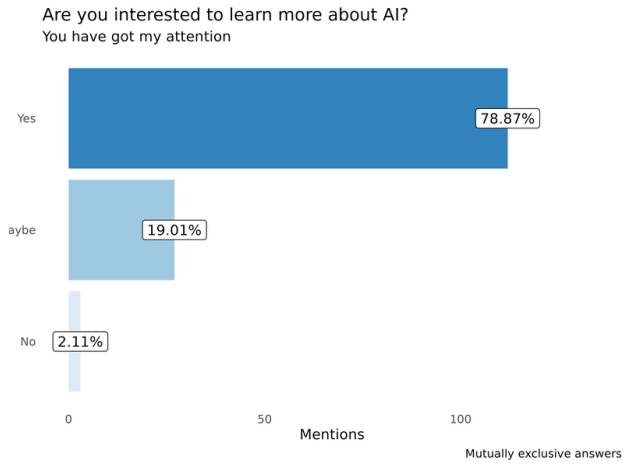

Exhibit 8

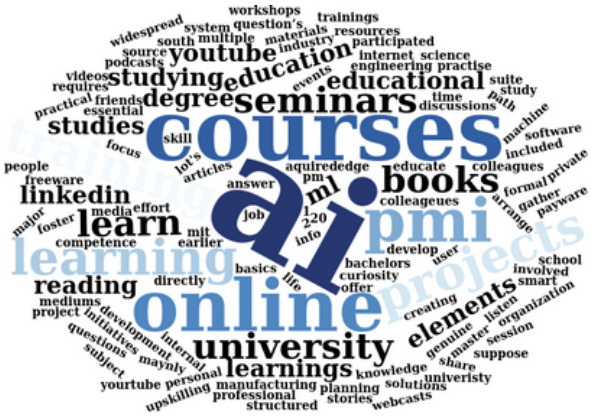

Exhibit 9

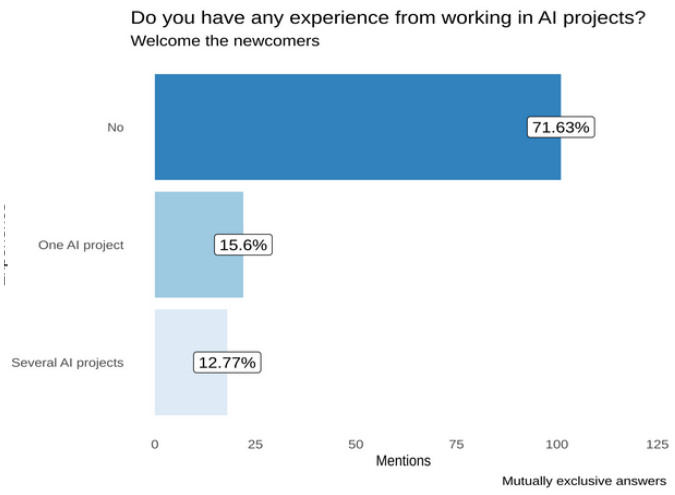

Exhibit 10

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Artificial Intelligence in Project Management: How-to

Most of our respondents are developing their AI solutions themselves and are acquiring Off the Shelf solutions as well (Exhibit 11). This is an interesting insight as most AI solutions come from large technology brand names and consulting firms. However, it has been noted before in the AI literature that some business segments are prone to buy AI and others are prone to create AI themselves and a very few are both users and creators (McKinsey, 2018; Sinha et al. 2022).

This is interesting as AI development, notably Deep Learning, requires large amounts of data which may not be available to small companies and individuals. Also, proper deployment and generalization require deep understanding of the application domains which requires, by its turn, seasoned project management professionals and consultants.

So, if project managers are here to guide AI development, since we have data scientists and developers to create the AI tools, how do project managers see themselves in this brave new world. Which skills are required in this new setting?

The answers were unsurprising as most respondents pointed out soft skill-related options instead of the obvious hard skills listed (Exhibit 12). Innovation, Privacy and Ethics were highlighted among the answers and data literacy, data science itself, and compliance issues were pointed last. This suggests that project managers are really wearing the hat of leadership and are much less interested in the so-called hard skills that were so much relevant in the initial decades of project management.

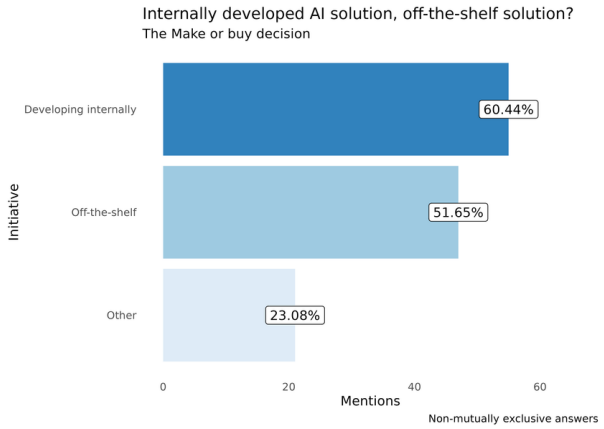

Exhibit 11

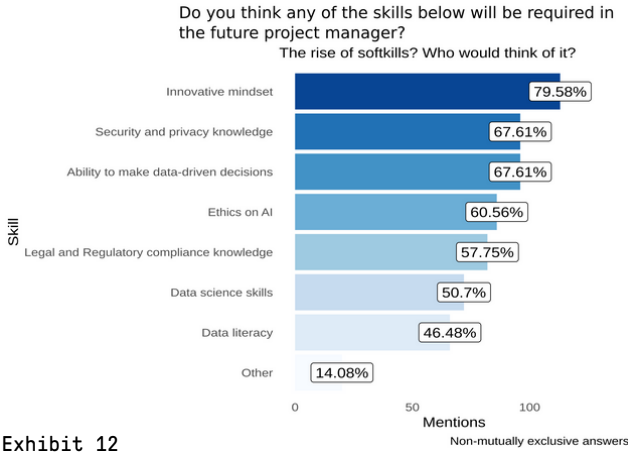

Exhibit 12

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These options were inspired by the Reskilling and Upskilling recommendations provided by PMI Megatrends (PMI, 2022) and the answers are quite similar. We also would like to emphasize some parallels with the PMI PMTQ (Project Management Technology Quotient). PMI suggests 3 essential features of a leader with high PMTQ (PMI, 2019): (1) Always on curiosity; (2) All-inclusive leadership; (3) A future-proof talent pool. The answers in Exhibit 12 suggest some convergence with such values in "Innovative Mindset" (1); "Data Science Skills" and "Data Literacy" (3); and "Ethics on AI" and "Ability to make data-driven decisions" (2).

The areas in which project management practitioners are hoping to have help from AI are also interesting issues (Exhibit 13). Most of them expect AI to automate recurrent and mechanical tasks such as data collection and reporting. The presence of Scheduling, Risk management and Cost management is also remarkable since these areas are the easiest to implement AI tools as they are based on simple tabular and numerical data (Ruiz et al., 2020; Gerbert et al., 2017). They are also the areas in which AI tools are being developed and deployed right now (Perez et Blasco, 2022). The presence of Stakeholder Engagement is also notable as this application is one of the most challenging in AI development regarding both development and ethical issues (Nuhn et al., 2022; Abdalla, 2021; PMI, 2019, Li, 2018).

Once again, we can explore this data even further by combining data on industries and how they are getting their AI solutions.

Government is prone to acquire technology from the market whereas Software and Retail are leaning toward creating the technology themselves (Fehling et al., 2022). This reflects the current distribution of AI in markets where Financial Services, Software and Facilities have been using AI for some time whereas "non-traditional" AI users are acquiring ready-made solutions from the markets (Exhibit 14). A report by Bain (Sinha et al., 2022) points out that the Make-Buy decision on AI is not a simple two-way choice, but a continuous spectrum that ranges from the pure AI Developers to pure AI Users.

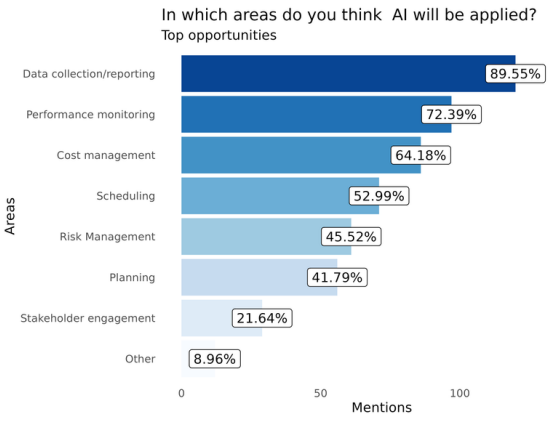

Exhibit 13

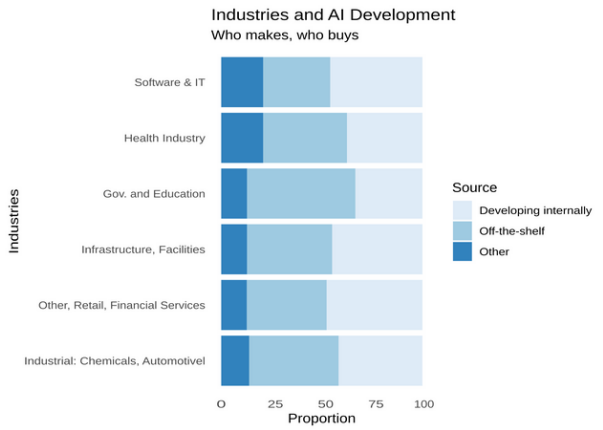

Exhibit 14

Exhibit 15 reflects the current talent distribution of talent in the market. Industrial users contain more beginners in their payroll while facilities and retail have most of the talent. Curiously, the government has the talents but has been under-exploring their potential. As this question relates to talent management, an always challenging activity, let's explore it a little more. Report by Bain (Sinha et al., 2022) points out that India has been the major source of AI talent globally as it produces more talent than it consumes. Also, most organizations lack the domain-specific expertise required to further develop more advanced AI applications and this is relevant in our discussion of AI in project management as our practitioners are the people with such expertise.

However, Artificial Intelligence tools are used by project managers but are developed and bought by organizations (Exhibit 16). So, how are organizations doing? Here the situation changes as most organizations have no firm plans on implementing AI tools, only 27% of the organizations have already deployed AI technology and 13,8% are still starting.

PMI Pulse of the Profession (PMI, 2019) points out that some organizations are the leading innovators in AI development and deployment. They point out that the innovators, aside from having plans in AI, also are more experienced in leveraging its potential. Some top technologies presented in the Pulse of the Profession and used by the AI Innovators are: Knowledge Based Systems, Decision Management, Voice Assistant, and Robotic Process Automation. Curiously, Deep learning is among the less used technologies among the leading innovators. Why? Because AI is more than just Neural Networks. Bain's report (Brea et al., 2019) also points out that successful deployment of AI-based products in consumer packaged goods industry is correlated with laser focus on the use cases instead of scattering small efforts among many possible applications (AI Focus Leaders, as they say). On the other hand, AI optimistic leaders are only 15% effective in deploying their AI-based project, suggesting a low survival rate of such projects. BGC's report on aerospace (Fehling et al., 2022) also presents a similar situation, where organizations struggling to exploit AI are having troubles with strategy, talent and data governance.

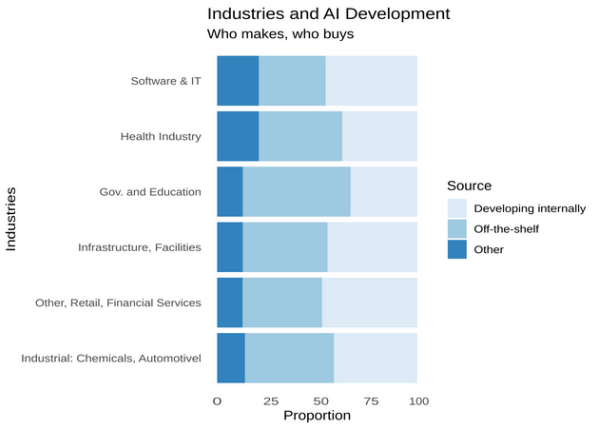

Exhibit 15

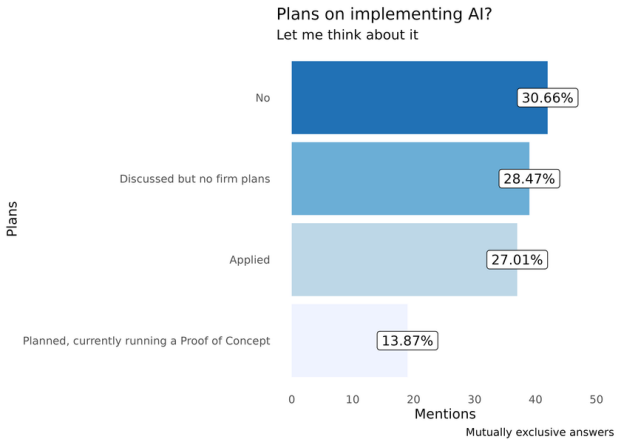

Exhibit 16

Highlights of the report

Over the next three years, project professionals expect the proportion of projects they manage using AI to jump from 23% to 37% (PMI, 2019). The pandemic greatly accelerated the expansion of digital technologies, especially tools to enable online collaboration and remote work. The trend toward remote work had been gaining speed, facilitated by digitization and improved connectivity.

But any barriers or hesitation about adopting a remote model were swept aside as the ability to work from home became mandatory to carry on normal business. This shift looks likely to become entrenched in the foreseeable future. Companies also rushed to bring new digital offerings to market. According to McKinsey (PMI, 2022), the rate at which companies introduced products and services that are digital in nature advanced by six years in North America, seven years in Europe, 10+ years in Asia-Pacific and seven years globally. Results vary across sectors, with the most significant increases occurring in healthcare and pharma, financial services and professional services (Aung et al., 2021; Sinha et al., 2022; Goosen et al., 2018).

Artificial intelligence (AI) is no longer relegated to advanced IT and technology applications. AI has already begun making its way into more traditional settings to enhance or supplant tasks traditionally done by humans — including project managers. What does that mean? What do project managers need to know to stay sharp as this emerging technology has potential to impact the future of the profession?

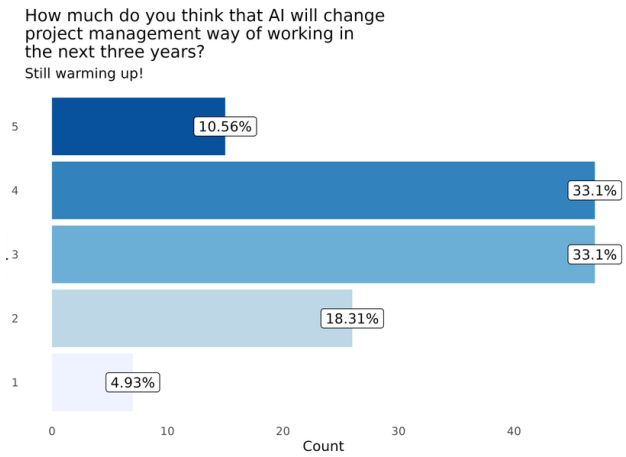

Exhibit 17

Contrary to our expectations, most of the respondents are optimistic about the impact of AI day to day work of the project managers (Exhibit 17). However, 66% of the respondents are between medium and medium-high impact. Only 10% are eager to see the new ways of working and 23% are so-so about it. We are going to explore the information further by combining it with previous data.

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5 implications of Artificial Intelligence for Project Management

01

Organizations — and project managers — see an imminent impact from AI.

Over 80% of respondents to a recent PMI "Pulse of the Profession®" survey report that their organizations are seeing an impact from AI (PMI, 2019).

02

Project managers will increasingly be called upon to implement AI-focused projects.

Rolling out AI implementations will require project managers to lead those projects. Does that mean project managers need to be AI experts? Not necessarily, but they do need to understand that these aren't typical IT projects (Nilsson, 2022; Center Stage, 2021).

03

AI tools can analyze data from current and previous projects to provide insights.

Data analysis can do much more than estimate costs and schedules, however. Project managers will continue to steer projects through difficult decisions and unexpected obstacles, using AI for guidance and insights based on data.

04

AI-powered tools will take over administrative tasks for project managers.

AI-based tools can take over functions like meeting planning, reminders, day-to-day updates and other administrative tasks. This will free up project managers and team members to focus on higher-level, complex activities and planning. According to a report from KPMG (KMPG, 2019), "AI Transforming the Enterprise," organizations who have invested in AI say they've seen, on average, a 15% improvement in productivity.

05

AI systems can help keep projects on schedule and on budget (Abdalla, 2021).

"We've not been terribly good at estimating how much projects will cost and how long they'll take," said Tom Davenport, professor and author of 'The AI Advantage: How to Put the Artificial Intelligence Revolution to Work' (Davenport, 2018). By using AI-powered data analysis that looks at data from past projects, we'll be able to predict, with a much higher degree of confidence, how much a project will cost and how long it will take," he explained on an episode of the PMI Center Stage podcast (Center Stage, 2021).

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Decomposing the estimated impact of AI into the roles of project managers (Exhibit 18), we can see that business people are less hopeful about AI's impact on day-to-day work, while Other and most project managers are quite optimistic. It is also interesting to note that Predictive practitioners have a more evenly distributed opinion while Adaptive practitioners are concentrated around the medium impact.

We need to add that, as seen before, as Business people are less literate about AI technologies, they are less able to make predictions on the impact of such technologies on their business. This last insight is in tandem with a report by McKinsey (McKinsey, 2018) which mentions that business leaders are still uncertain about the true impact of AI, both in strategy, financial benefits, and use cases. In the same report, they point out the relevance of Analytics Translators, which are professionals able to establish communication between Business Leaders and Analytics related talents (Data Scientists, Visualization Specialists, etc).

Organizations will continue to invest in AI to augment skills like decision-making, risk management, data analysis and knowledge management. But if and when AI proves capable of replacing human-like intelligence is a subject of much debate and speculation. In November 2021, Eric Schmidt, former CEO of Google, joined by former U.S. Secretary of State Henry Kissinger and MIT computer scientist Daniel Huttenlocher, suggested that our future course should neither be to defer to AI nor resist it, urging us instead to focus on "shaping AI with human values, including the dignity and moral agency of humans" (Kissinger et al, 2021).

Augmented Intelligence emerges as a possible choice on how to deal with AI (Fernandez et al., 2021; Ransbotham et al., 2020) as it combines human expertise with a machine's capability in dealing with unbelievable amounts of data. In such a context, the machine learns with human interaction and humans learn by teaching the machine itself. Although, this approach is not

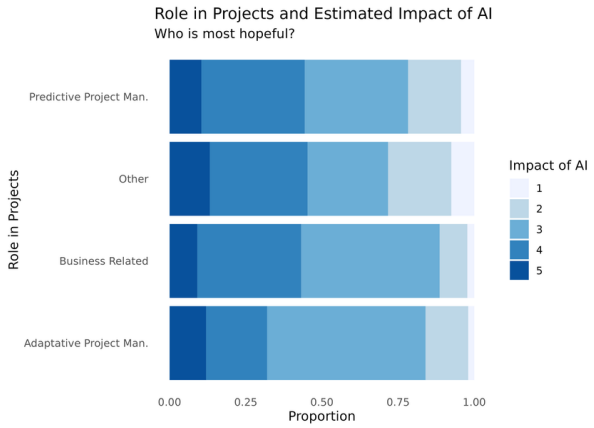

Exhibit 18

enough to solve the concerns regarding AI like ethics and representation.

These concerns will require a sharper focus as we advance into the digital future. To support the meaningful application of AI, organizations will need to invest in acquiring or training IT and data specialists, create a strategy for data governance and maintain transparency. Protecting the confidentiality, integrity and availability of data must be an essential part of any response to these future-focused business initiatives.

Judging by the result there is a clear rise in soft skills, like an innovative mindset, closely followed by the ability to make data-driven decisions. Using Artificial Intelligence to augment the project manager and team will free up the time and let the AI take over more repetitive, administrative and analyzing large volume of data (the strength of AI) to focus more on adding value to the project by taking more time to stakeholder management to reach expected project goal and objectives and better management of risk and decision making. As number 3 we find security and privacy knowledge which is on top of many CEOs' attention due to Cybersecurity issues, protecting IPRs, customer data and integrity. Another huge strength is AI detecting anomalies in patterns, but man needs the knowledge to make decisions. We can also segment these demands according to the the industry:

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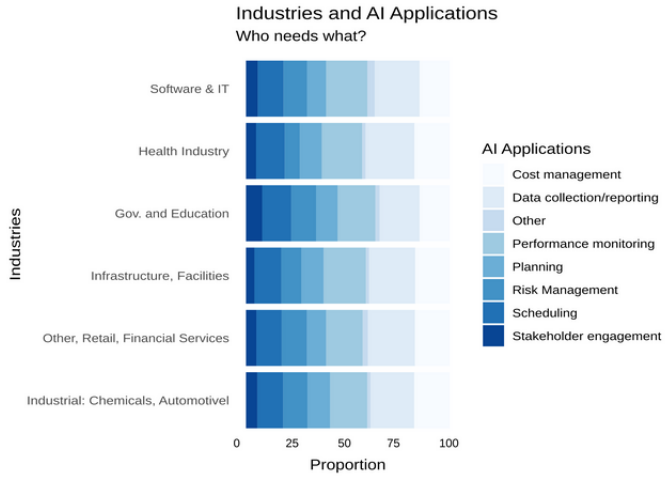

Exhibit 19

All industries see value in the applications pointed out by our respondents, but they have their preferences (Exhibit 19). Government is more interested in Stakeholder Engagement whereas Health and Industrial companies are mostly interested in Cost management. There are some obvious trends, Infrastructure and Facilities deal with very tangible projects which are mostly ruled by technical and objective aspects, so Stakeholder engagement is less demanding, human-human interaction is a hallmark of leadership positions, and such activities will enhance the relevance of human talent in the future (Abdalla, 2021). Everyone is focusing on data collection and reporting since this is basic AI activity that can be deployed right away.

Considering that close to 27% (2021, 21%) say that AI has been applied. This reflects very well the findings in the PMI Global Megatrends 2022 (PMI, 2022). With the ongoing initiatives where companies are currently running a POC or discussing implementing AI, there is a potential to double the penetration in the next three years to 48%. Previously in the report, organizations who have invested and are using AI claim to see on average 15% improvement in productivity. With the globalization, growth of online business and digitalization, these claims should be a wake-up call for laggards.

Further Perspectives from Specialists

We also asked some project management professionals about their opinion on AI directly, they were:

1. **Describe the type of services you provide in the project management market;**
2. **The changes in demand that you have seen in the project market in the last 3 years;**
3. **What are your prospects for the project market in the next 3 years?**
4. **What skills must the project manager have to remain competitive in this context?**

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ALEXANDRE DARGAINS, PROJECT MANAGEMENT CONSULTANT

1. Organizational consulting for structuring PMOs, projects and change management methods, also, as management of complex and multidisciplinary projects.

2. I have noticed a greater focus on organizational structuring aimed at project management rather than contracting project management services (outsourcing). Increased demand for organizational change management services.

3. There is reactive but expressive growth in the project market in Brazil. Large companies listed on B3 still do not have a project management methodology or structures. The increase in speed and uncertainty of changes has produced a search for project efficiency in these companies.

4. Self-knowledge, continuous learning, engagement and focus on the value provided by the project, digital self-taught, great communication, leadership, organization, discipline and emotional intelligence.

ANDRÉ BARCAUÍ, PROJECT MANAGEMENT CONSULTANT AND COACH

1. I work with consultancy in the area of project management and I coordinate the largest MBA in project management of an educational institution in Brazil.

2. There are several changes on the most diverse fronts: ESG, soft skills, etc, but the main one in my view is the use of AI for project management that lies ahead.

3. I believe we will make more use of data in management. Therefore, we not only need to know more about how to interact with machines but also how to manage AI projects. With the expansion of machines, managers will be freer to do what humans do best: their socio-emotional skills.

4. There are several, but I would focus (and I am focusing) on knowing more about how to relate to the machine, data science, and machine learning, among other points. The emotional part is also very important, but this one I've been training for a long time.

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GEETHA GOPAL, PANASONIC ASIA PACIFIC

1. I am in charge of the IT infrastructure projects delivery and digital transformation for my organisation across APAC. We run approximately 120 projects per year in this region in the infrastructure domain. Ranging from network transformations to end-user services, cloud hosting and servers to security, my portfolio also includes supporting our businesses on their digital transformation needs.

2. Since the onset of the pandemic, we have seen businesses coming forward to request for digital solutions to help them sustain and adapt to new ways of working. This means the demand (and mindset) has changed from IT driven to business driven. We have also seen a great increase in proactive security projects to mitigate IT security risks. Transformation initiatives are at an all time high, with their acceptance and success rates also being positive due to the pandemic.

3. Again, the focus for IT is on transformation. For organisations that are looking to grow and sustain, the next years will mainly be on one or all of the following - CX, DX, UX, EX... There will be more projects that focus on change and transformations.

4. Key skills needed are first and foremost empathy. In these dynamic times, it becomes more important to focus on interpersonal aspects and find the right balance with tangible deliverables. Project managers need to be empathetic, resourceful, technologically inclined and mindful of the business rationale in the projects they undertake.

MATTIAS BERGLUND, NEXER GROUP

1. I work as a consultant manager for a division of digital strategy experts. I also do consultancy work as a senior advisor in project management and digitalization.

2. As many large-to-enterprise sized companies have now gone through their agile transformations, I have seen an increase in demand for scaled agile solutions.

3. In the next few years, I believe we will continue to see data-driven approaches both in project management and in the projects we work on. Currently, we are seeing a focus on data analytics used for descriptive purposes but as technology advances, I believe the focus will shift towards prescriptive analytics and automation.

4. The trend towards data-driven project management means that high data literacy is becoming a must-have skill. Hybrid ways-of-working also puts high demand on the project managers ability to lead and motivate team members remotely.

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FREDRIK HOFFLANDER, EGHED

1. We as a consultancy help companies both how to use and integrate new tools, like advanced analytics and data science, into their project management portfolio. But also, how to lead and manage AI projects with new ways of working and processes like ML- and DataOPS.

2. More and more companies have realized that most decisions need to be based on insights and not gut feelings, making them start to work more and more data-driven. However, the most striking change I have seen is that companies are moving from PoCs to a more production- ready approach within the field of data science.

3. Within project management as well as many other management roles, predictions are an essential part of the job. Here I can see two major probable developments. Firstly, tools and techniques within data science that have been around for years (and sometimes decades) will be more widely accepted and used. Secondly, cutting-edge AI tools like GPT3, DALL-E, or similar are already starting to be really user-friendly. These tools will probably be as important for project management as e.g., Google translate or Grammarly is for writers today.

4. As always, one of the most important skills to have is curiosity. If I am not familiar with practices like MLOps, DataOps or even DevOps, I really have to start googling. It is also really important to understand that there exist a lot of experts within this field and a project manager's role can never be to be an expert in these techniques but an expert in gathering the right people in the same place. To be able to do that, knowledge about which experts exists and is needed will be a core competence.

JÚLIO MAIA, FORMER IBM BRAZIL

1. Management of Complex Projects, mostly on Telecom and legacy systems.

2. Leadership and autonomy of the Project Manager for the success of the projects. Older projects were "follow the plan", now we can think of each step.

3. Paucity of trained professionals to be part of project teams. Skilled professionals, for the teams are getting scarce, are we in a talent blackout?

4. Communication, Communication, Communication and balance in physical, intellectual, emotional and spiritual intelligence. The project manager is a leader, and as a leader, one must be complete as a person.

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Closing Remarks

The function and popularity of Artificial Intelligence are soaring by the day. Artificial Intelligence is the ability of a system or a program to think and learn from experience. AI applications have significantly evolved over the past few years and have found their applications in almost every business sector. Leveraging artificial intelligence to improve company processes is no longer a case of "if" or "why" but of "how".

The advantages of Artificial Intelligence are evident and proven. Organizations around the world and in every business understand that Artificial Intelligence, while currently a competitive choice, will soon become the business standard due to the advantage of improving both efficiency and the bottom line.

But as a growing number of businesses are in a race to deploy Artificial Intelligence, they are learning that building AI solutions in-house is exceptionally challenging. For this purpose, 70% of enterprises are choosing the vendor-supplied route to deploy Artificial Intelligence solutions. But once the choice has been made to use vendor-supplied AI software, the vendor type is critical. Until recently, the buy decision was mainly limited to off-the-shelf Artificial Intelligence software, but now, with the development of highly customized AI, the buy choice is becoming more complex allowing some organizations to collaborate in the creation of the solution.

The competition for talents has also been fierce, with non-ai companies buying ai-companies, not for their technology but its teams. As AI/ML applications are simply mathematical functions, the technology is highly replicable with proper data and team. Previous limitations, like hardware, are being solved by cloud computing and SaaS, a commonplace in AI development. This creates an entirely new challenge for mergers and acquisitions teams and the phenomenon is so widespread that the "acqui-hiring" term was coined to describe it.

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Attachments: Glossary

Statistics: is the science that deals with data collection, analysis and summary. Formally it is a division of mathematics that deals with uncertainty.

Multivariate Statistics: Generally, the statistics we learn and use on a daily basis are uni-variate, only one variable is in focus. More advanced applications use multiple variables simultaneously which is mathematically complicated.

Data Science: It is a multidisciplinary area that combines a strong foundation in statistics with elements of programming (software), visualization (graphics) and other areas of mathematics such as Numerical Analysis (approximations), Calculus (optimizations), etcetera to extract intelligence from data. A suitable synonym would be Data Mining (Dastyar et al., 2017), which is a term that had lot of traction in the 2000s.

Big Data: It is synonymous with Data Mining, but focused on big data (the 3 Vs of Big Data). Big Data is to Data Science what High-Performance Computing is to Scientific Computing (Kuster, 2021).

Machine Learning / Statistical Learning: It is a data science tool that tries to automate the process of creating a stochastic model from a data-set instead of deeply analyzing the relationships between variables. (Abdalla, 2021).

Deep Learning: It's basically the same thing as machine learning, but the field specializes in using neural networks. The area differed from Machine Learning as it was considered more advanced and closer to Artificial Intelligence (Abdalla, 2021; Ko et Cheng, 2007; Kahlil et al., 2022).

Artificial Intelligence: An area of mathematics that seeks to model the decision-making, learning and reasoning process of the human mind. It is one of the fringes of science and is best known for Fuzzy Logic and other decision-making techniques. Roughly speaking, Machine Learning and Deep Learning are subareas of artificial intelligence but neither is AI by itself (Abdalla, 2021; Kahlil et al., 2022; Fehling et al., 2022).

Operations Research: An area of mathematics closer to optimization and numerical analysis than to statistics. Operations research solves planning problems and depends on predefined deterministic or stochastic models and therefore can be the next step after Machine Learning, can be used by it or can be replaced by it (Fehling et al., 2022).

Model: "a simplification of reality" is the textbook definition. The purpose of a model is to be a practical approximation of what it seeks to model. In data science, models are the approximation that will be used for the problem.

NLP: Natural Language Processing It is one of the most complex areas of Machine Learning, one that has only recently advanced thanks to Deep Learning. NLP consists of extracting information from human voice and text, both from documents and social networks (Nuhn et al., 2022;; Abdalla, 2021).

Structured and Unstructured Data: Structured data, or Rectangular Data, is the data we are used to, such as numerical data in spreadsheets or discrete data in the same format. Unstructured data is anything else such as images, sound, (written) text, simulation data, and so on.

Pipeline: Literally a production line. When an organization has mature data science processes, a pipeline would be the entire sequence of the data life-cycle, from capturing data in situ to issuing the opinion or dashboard at the end of the pipeline.

Unconstrained Optimization: This is a class of optimization problems. The very process of generating the ML/DL model, also known as "training" is an Unconstrained Optimization problem.

Web-scrapping: Very common before the popularization of APIs. It consists of loading a web page via scripts and trying to extract some information (usually text) from there in an automated way. It's very effective on open social networks (like Twitter, although the API supports the same) and sites with an obvious structure (like stores).

Premise: Premises are those facts that we assume to be true, but could be wrong. Assumptions in projects imply risks, but in mathematical models, assumptions indicate under what conditions a model works. If the premises are disregarded, the model behaves unpredictably.

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Supervised Models: These are those in which for each data set a known answer is given in advance. In a nutshell: "Follow the Lead".

Unsupervised Models: In this case, models are used to find and expose patterns in the data structure that can be exploited by other models.

Linear Models: They are the simplest type of model to make, explain and use, but they rely on linear correlations which is quite unusual in the real world.

Logistic Model: It gets its name from the Logistic Equation that is known to those who work with differential equations. It is one of the first classification models learned in machine learning and is used in deep learning as well.

Nonlinear Models: These are models that cannot be described as a linear combination. Resolution and visualization techniques change, but the basic principles remain the same.

SVM / Support Vector Machines: It is an alternative model to multivariate linear models, but it can be extended to non-linear cases with the help of data transformations (kernels). They are very popular because they result in a minimally explainable equation and are almost as versatile as a neural network (Chandanshive et Kambekar, 2021; Cheng et al., 2010; Kahlil et al., 2022).

Cluster: Clusters are groupings that are made in various ways, but mainly by distance and density. Cluster analyses are performed as part of exploratory analysis, a way of trying to identify patterns and structures in the data when they still have an unknown structure. They are one of the unsupervised analysis techniques (Cheng et al., 2012).

Explainability: It is the possibility of explaining how a model works. When the model is an algebraic equation the explanation is obvious when it is a cluster or a tree it complicates, but it can be explained, when it is a neural network there is no way to explain it. The neural network is a tangle of equations interconnected by tensors, even mathematically it is difficult to explain. So when a neural network does something inexplicable, it's extremely difficult to interpret why a decision was made. When the decision was incorrect, the correction often costs as much as creating the network.

Overfit: When creating a model, if it is a poor approximation of the data it is said to be under-fitted; if it excessively approximates the correct result it is said to be over-fitted. An under-fitted model is useless, an over-fitted model too, but you only discover that too late. Over-fit models are perfect approximations of the data set used to create them and are unpredictable outside of this context. They may also be biased because the data has a representation problem.

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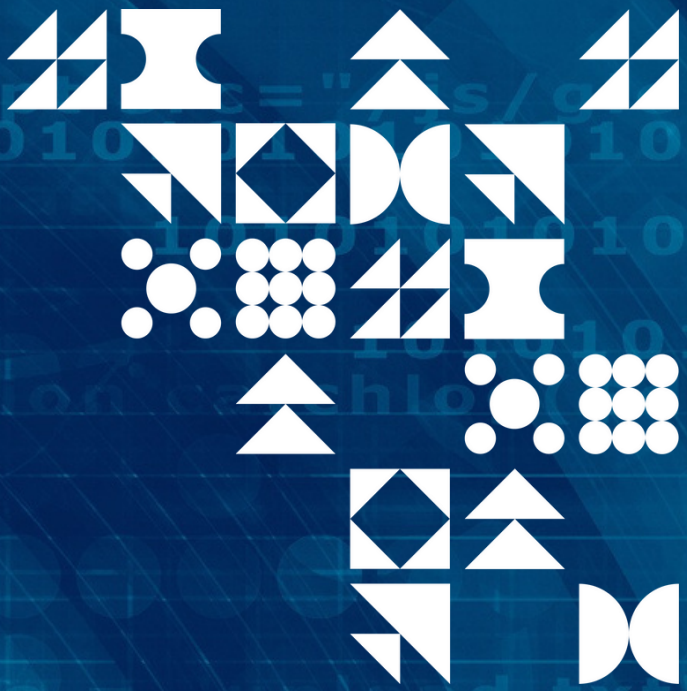

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