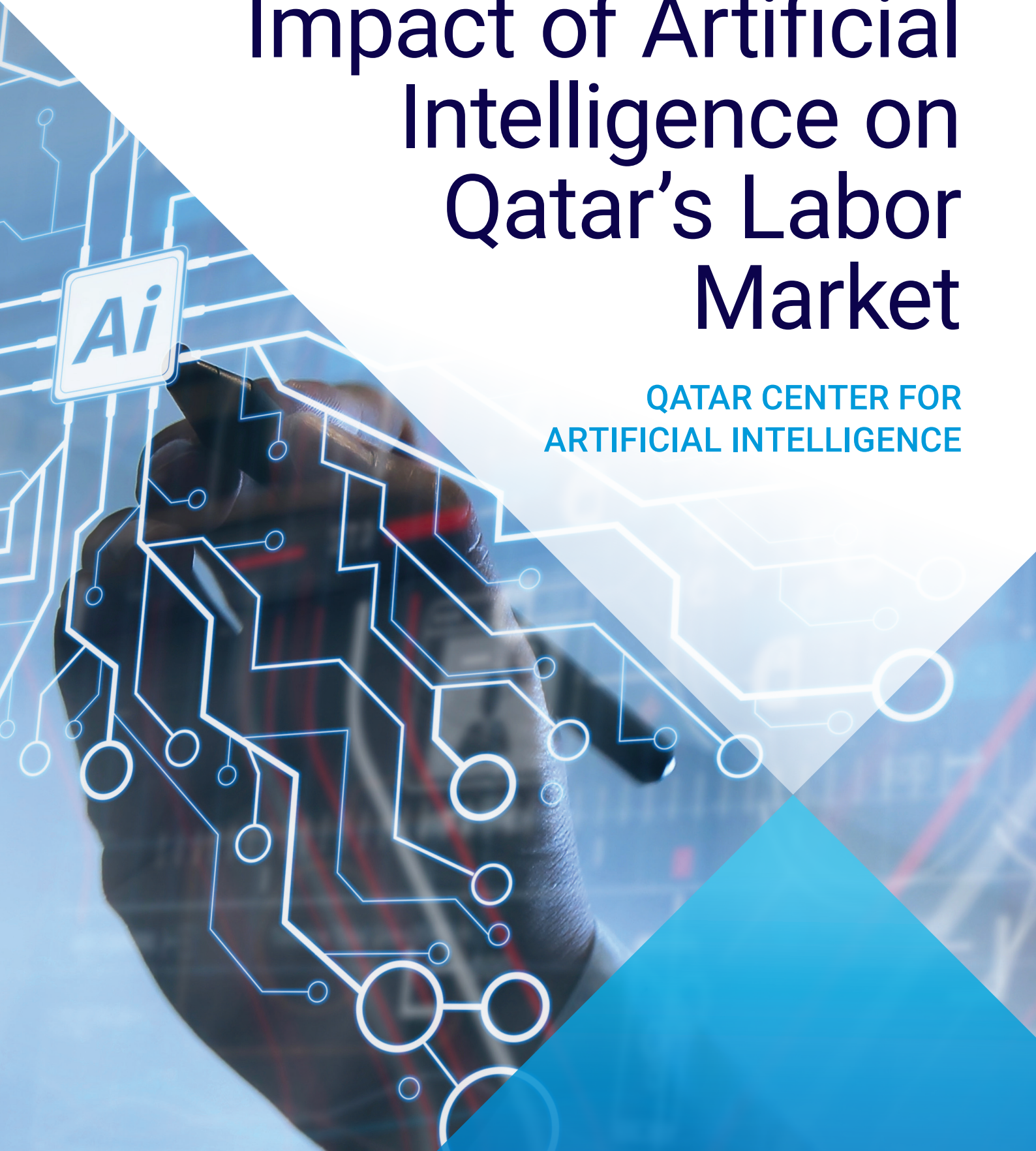




Impact of Artificial Intelligence on Qatar's Labor Market


QATAR CENTER FOR
ARTIFICIAL INTELLIGENCE



Executive Summary

Artificial Intelligence (AI) is a transformational technology, and its usage has been steadily permeating our daily lives. The COVID-19 pandemic and the dramatic shift towards an online work environment has accelerated the adoption of AI-driven systems. AI is a step up in the automation ladder and is expected to alter the very nature of jobs and the employment landscape. Qatar released its National Strategy for Artificial Intelligence (hereafter AI Strategy) in October 2019 and proposed an AI-augmented workplace as a key pillar around which Qatar's vision of transitioning to a knowledge-based economy can be realized.

In this paper, we elaborate on the role of AI in the workplace and the future of employment in Qatar. To help policymakers make informed decisions on how to respond to AI enabled growth and automation, we built an AI based method to measure the automation impact of AI on existing jobs in Qatar, termed AI Impact Score (AIScore). While we speculate on the types of new jobs that are likely to emerge, we do not quantify the number of jobs that will be created. Before the analysis, we collected over three million US patents, downloaded one large database covering various aspects of most jobs in the US, and then map those to the Qatari jobs data from Planning & Statistics Authority and Indeed.com. We summarize our key findings below and provide a deeper justification subsequently.



Key Findings

I. The Extent of AI Impact:

As per our analysis, nearly half (~46.5%) of the tasks that comprise all of Qatar's jobs can be automated with AI-based augmentation using existing technologies, or those that have been patented. While our innovative AIScore model is new, we adopted the main approach from a recent study conducted by researchers at Stanford. For comparison sake, we also adopted the Stanford study's results for Qatari data and derived a figure of 39.4% of tasks in Qatar getting automated. The effort reduction (or productivity gain) achieved translates into 670,064 full-time equivalent (FTE) expat jobs and 49,764 FTE Qatari jobs. These figures do not represent the number of existing jobs that would be completely automated away. Full automation is neither likely, nor desirable, but the activities performed in most jobs will see a significant change due to AI.

AI Impact translates into 670,064 full-time equivalent (FTE) expat jobs and 49,764 FTE Qatari jobs

II. Sectoral impact:

Eight out of the twenty-one sectors of the Qatari economy will be heavily impacted as they have a higher than average AI Impact score. AI is primarily geared toward cognitive tasks, so white-collar jobs that involve tasks like information collection, verification, and decision-making based on routine analysis of data will be impacted. Most workers employed in white-collar jobs in sectors like Government and Finance will need support in transitioning.

III. Opportunity:

As per 2018 estimates, AI will contribute up to US\$15.7 trillion to the global economy in 2030, of which the Middle East region is expected to accrue US\$320 billion in growth. AI's contribution

to the GDP of Qatar is expected to be 8.2% by 2030. For Qatar, a future based on AI technology can be a windfall. Many countries are wary of aggressively adopting AI technology, as a large workforce displacement may result in increased initial cost to upskill workers and potentially cause social disruption. In Qatar, 95% of the workforce is made up of an expatriate population that has a high turnover rate. The feared AI trade-off between economic growth versus income inequality is unlikely to hold in Qatar.

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IV. Qatar's competitive advantage:

To compete in an AI-driven environment, nations need to be ahead on three fronts (i) data, (ii) infrastructure, and (iii) talent. Nations can control data within their borders, but advantages in infrastructure and talent are harder to build and sustain. While Qatar has always invested in world-class technology infrastructure, much more important is the country's investment in building an exceptional higher education and research ecosystem. The World Economic Forum (WEF) has recognized Qatar as a leader among MENA countries in two categories of vital importance for building AI-based automation. Qatar is top in 1) Quality of MENA's education systems and 2) Ease of finding skilled employees in MENA. As such, in the MENA region, Qatar is competitively positioned to take advantage of the AI revolution.



As per WEF, Qatar leads the MENA region in:

1 Quality of education systems

2 Ease of finding skilled employees

Recommendations

The above findings make it imperative for Qatar to pursue an aggressive and opportunistic embrace of an AI-driven future, as envisioned in the AI Strategy. To achieve this, the country needs to do the following:

I. Building a data-centric work culture

Data, a by-product of digitization, is the primary building block of modern AI systems. Organizations in Qatar need to build a data-driven evidence-based work culture. This will be the key enabler for Qatar in its transition from a resource-based to a knowledge-based economy. A data-driven culture enables every worker to make better and more informed decisions using data. AI is essential to realize this potential. To achieve this, organizations will have to start by reviewing their processes for understanding gaps in data, its opportunity costs, and the efforts required to transition.



Organizations in Qatar need to build a data driven culture that enables every worker to make better and evidence-based decisions.

II. Lifelong learning as a new way of living

Qatar needs to instill a new ethos of lifelong learning in its institutions, society, and the economy by building cultural acceptance for this new way of life. The need for the existing workforce to be upskilled for working in AI-augmented environments will be a continuous one. The education curriculum in schools and higher education must reflect the prominence of AI for the next generation of Qatari citizens to become AI-savvy and comfortable working with "intelligent systems". Even the role of family and society in an individual's life will have to evolve.

- ▶ Need for upskilling will be continuous and lifelong.
- ▶ Curriculum in schools in higher education needs to evolve.
- ▶ Awareness campaigns needed to build a social consensus around this new culture of lifelong learning.

III. Supporting workers in this transformation

Beyond retraining opportunities, providing

unemployment insurance, counseling, and other kinds of support during the transitions is vitally important. Employers should be encouraged to facilitate such AI adoption. As individuals, people are very resilient to change and adapt fast if given agency. Qatar should help workers in assessing the AI Impact score for their specific jobs and recommend personalized learning pathways for upskilling and augmenting themselves with AI tools and skills that are resistant to automation.

AI Together Portal will be launched to:

- 1 Help workers in accessing the AI impact scores for their jobs.
- 2 Recommending workers personalized learning pathways for upskilling.

This will support the workers by helping them define their continuous learning journeys. The 'AI Together' portal, which will provide such services, is currently scheduled to launch early next year.

IV. Sectoral focus areas:

We analyzed data in all sectors of Qatar's economy. Among the factors considered were AI Impact score, strategic importance, the differential impact of AI on Qatari population, and whether a sector is government-driven or market-driven. Based on this analysis, we recommend the government prioritize its efforts and investments to help transition organizations and workers from the following sectors of Qatar's economy (see box below).



Examples of How AI Can Transform Jobs

Monitoring & Evaluation Specialist

Mariam Ahmed's background is in Liberal Arts, and her strength is to take complex information and transform it into clear and crisp written summaries. As a senior advisor in the vice-president's office, Mariam oversees compiling all the KPIs in her division and creating summary reports for senior management. Mariam spent a disproportionate amount of time collecting information from office stakeholders in support of the KPIs. Data often came in the form of spreadsheets, emails, and document attachments. Ambiguity in matching the data to the definitions of KPIs required constant resolution. There was considerable back and forth between her and office colleagues, limiting her time to synthesize information and present a coherent narrative to senior management.

Mariam is now working with the Qatar Center for AI (QCAI) on a pilot to create an AI-based evidence-gathering system. Stakeholders responsible for delivering on the KPIs are asked to note outputs in the free text on Google docs and share the link. The AI-based system uses Natural Language Processing techniques to match the text against the KPIs and automatically populates spreadsheets and produces basic reports. Mariam occasionally steps-in to rectify the mistakes made by the AI system. Every intervention by Mariam improves the system. As more data is collected, the accuracy of the AI-based system increases. Mariam now has more time to review the AI-populated reports and summarize the division's progress against the KPIs. A lightweight AI system perfectly augments her role and allows her to do work in which she excels.

Maintenance Technician

Hanif Mohamed is a field technician for a major utility company in Qatar. He is part of a team that is routinely deployed to maintain self-regulating substations. With climate change, utilities are experiencing non-standard workloads on the network, resulting in more field visits by Hanif to recalibrate the equipment in substations. The utility company decided to purchase an AI-based Maintenance Management System (MMS). By examining past data, the MMS can prepare a maintenance plan even before Hanif arrives at the substation. The MMS also provides recommendations on what tools to take to the field. The MMS can carry out "predictive maintenance" and will recommend which parts need to be changed before they fail. The MMS's deployment has resulted in considerable cost reductions for the utility company, as the average time per field visit has declined considerably.

Future AI-Centric New Jobs in Qatar

As much as AI is about prediction, it is difficult to envision what specific new jobs will emerge in an AI-driven economy. If history is a guide, however, then every technological change is accompanied by new roles that previously did not exist. A classic example in the "Internet Age" is the role of a Search Engine Optimization (SEO) specialist, whose job is to make web content and products easily discoverable by search engines.

An AI-driven future will be data-driven, so for Qatar, new jobs are likely to emerge in areas where the country has made strategic investment choices and has niche data advantages. The AI Strategy has a list of areas where Qatar has "natural advantages." With these in mind, we speculate that the following roles could find a foothold in Qatar.

Personalized Educators

The COVID-19 pandemic has caused immense disruption in the education ecosystem. The move to online education has been dramatic and swift. Educators who can craft personalized lessons and use the feedback from the interaction to create optimized learning pathways are likely to gain prominence. Qatar has made huge investments in building a world-class education system, and while some of the physical infrastructure may become redundant, the educator-to-student online interaction will most likely be catalyzed as a result of investments in the education ecosystem.

Algorithm Trainers

As AI algorithms learn from the data and feedback, a new kind of job to emerge would be of algorithm trainers, who will train these AI machines to perform flawlessly in increasingly complex situations. This job will involve creating new test cases, labeled data at large scale, and providing feedback to algorithms on their actions. Such a job will require deep expertise in both the application domain and a good understanding of how AI algorithms learn. Qatar's cosmopolitan population can provide ample data and opportunities to train AI algorithms to be used as products and services by the people of different ethnicities, nationalities and languages.

AI Auditors

AI systems could potentially take decisions that discriminate any group of people, or unduly hurt individuals. Similarly, AI systems could also nudge people using them to take progressively aggressive actions that can't be justified morally, or even legally. Considering the rise in discussions about regulating AI algorithms and making them accountable, a new profession of AI Auditor is all set to emerge. Their job would be to test and certify whether AI algorithms are in complying with the laws of the land and are ready to be deployed in real-life situations. In the MENA region, Qatar can take lead in AI Audit space by developing appropriate audit frameworks built around the Islamic jurisprudence principles.

Strategic Advisors

We know that AI has been automating most of the mundane tasks and has also forayed now into the well-defined cognitive tasks. Therefore, we expect a new role for the generalists who can visualize the holistic picture in any situation, often fast-paced ones, and make good judgment calls to achieve their objectives utilizing an array of specialized AI tools as and when needed. In a virtual world. This will be a niche that is bound to grow fast along with AI adoption. In Qatar, demand for AI-savvy Strategic Advisors will increase in the areas of medicine, event management, finance, and national security.

AI Impact Score

In our analysis, we looked at the patent data to determine the technology's capabilities. The information presented in the figure below is based on what is possible, given the current state of technology. Future developments will only expedite these trends. We found that 46.5% of tasks across all jobs in Qatar's economy can be automated using currently existing technologies.

Consequently, with the aid of AI technologies, workers in Qatar will, on average, spend roughly half of their time doing their current work. The additional time available could be used to focus on more strategic and complex tasks.

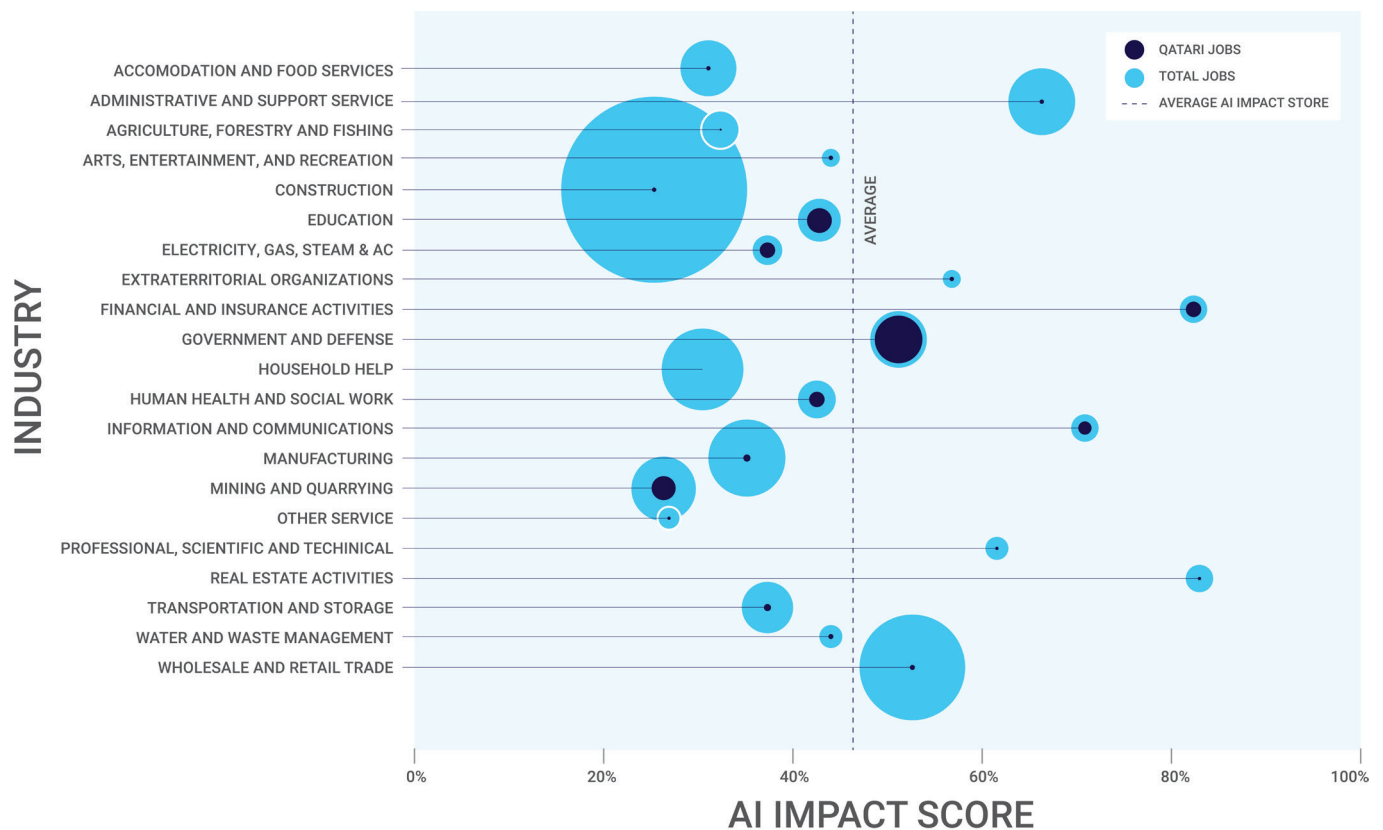


Figure 1: Industry-wise Potential of AI Impact in Qatar

Based on the FTE numbers, we estimated that in Qatar a total of 670,064 ex-pat jobs (FTE) worth of effort reduction or productivity gains are possible with full adoption of AI technologies that exist today. For Qatari jobs, the same calculation yields a potential effort reduction worth 49,764 FTE jobs. Also, as the number of jobs occupied in each sector by Qataris is different, the automation impact calculated in terms of FTEs is also significantly different.

Appendix I: Data and Methodology Used to Calculate AIScore

Overview

Organizations are in constant pursuit of achieving greater productivity growth, which happens through efficiency gains enabled by technology driven automation and innovative restructuring of work.

To quantify the automation impact of AI technology on jobs, we developed an AI Impact Score (AIScore) based on the following assumptions:

- ▶ A job is a collection of many different and related tasks to be performed by an employee
- ▶ The state-of-the-art of technology determines what can be potentially automated at that time
- ▶ Patents are a good proxy for the state-of-the-art of technology at any given time
- ▶ The extent of similarity between a task's description and AI patent texts determines the likelihood of automation for the task i.e. greater the similarity, the higher the automation potential
- ▶ The automation impact of AI technology on tasks that make a job can be aggregated to measure the job level AI impact, and it also rolls up at the higher-level groupings like the industry sector

Based on these assumptions, we developed an AI model to calculate the AIScore as the extent of similarity between the task descriptions and the AI patents using an advanced Natural Language Processing (NLP) technique – word embedding vectors. This allowed us to calculate AIScore in a scalable manner.

We built on the approach used by Michael Webb and other economists who analyzed the automation impact of AI and other technologies, but we used AI tools for our analysis.

Data

We started by selecting all AI-related patents and built a corresponding dataset for training our AI model. We collected three million patents, half of which were specifically related to AI from the past

15 years and the other half consisted of patents in other areas. This helps our model learn to identify what is AI, and what is not AI, thereby significantly decreasing the chance of an AI patent being misclassified by our algorithm. Patent examiners in most jurisdictions (US, EU, China, Japan, and many others) use Cooperative Patent Classification (CPC) for classifying patents by primary application and technology areas. We used a curated list of CPC codes that cover all AI patents to create our AI patents dataset.

Next, we downloaded the O*NET database developed and maintained by the U.S. Department of Labor/Employment and Training Administration. It is an extensive dataset covering most aspects of job/occupations in the US market. The O*NET database has been widely used worldwide by similar studies on the impact of AI and automation on jobs. The information of interest for us in this database includes the data on 20,000+ tasks from 1000+ jobs, and ratings on the importance, frequency, and relevance of those tasks in each job. We then mapped the job descriptions in the O*NET database into industry sectors specified by Qatar's Planning and Statistics Authority's Labor Force Surveys to arrive at the industry-level AIScore.

Methodology

To calculate AIScore, we measured the similarity between task descriptions and the text of AI patents. At first, we built an AI based classifier to determine the AI patent coverage levels of all CPC categories. Then for each task description, we identified the most similar patents. That provides us with CPC categories most similar to the task analyzed. Specifically, we used word embedding vectors at the level of sentences and phrases in patent titles, abstracts and O*NET task descriptions. What made this approach unique and easy to intuitively verify, is that one can add multiple vectors and the sum-vector will represent the combined meaning of all

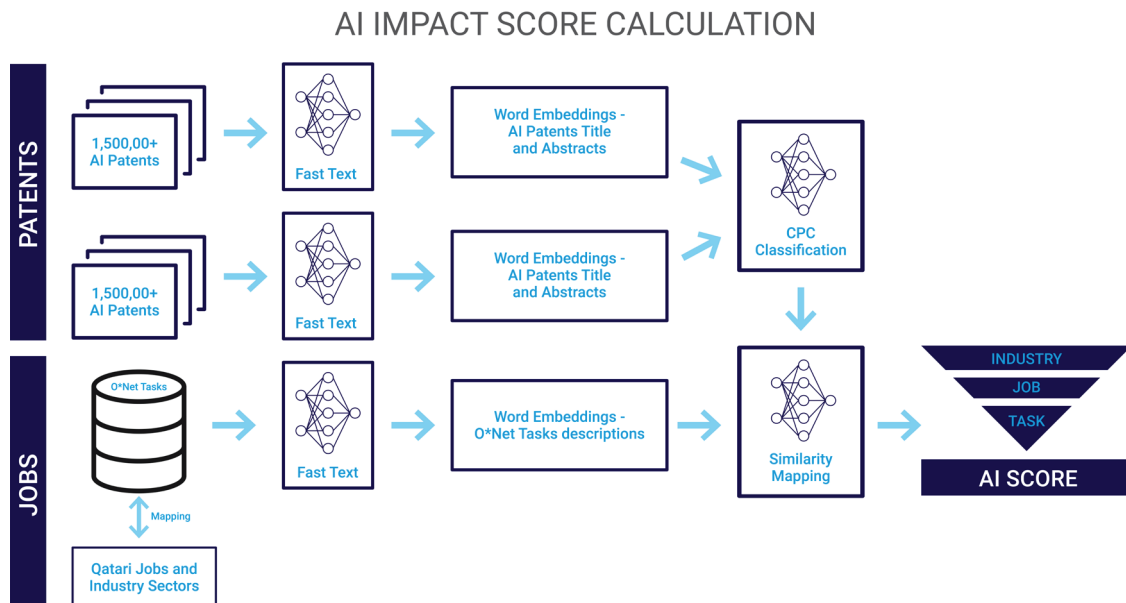


Figure 2: Approach for AI Impact Score Calculation

of the vectors, i.e., adding vectors for each word in a sentence will give you a vector that conveys the meaning of that sentence, and so on. Such vector embeddings are very effective at processing textual data. Best vector embedding techniques outperform humans in many standard benchmarks, including question answering. We used the open-source FastText embedding in a 300-dimensional vector space because it is compact, effective, and is used by Google Patents. We also used FastText to embed O*NET tasks in the same way.

Once patents and tasks are embedded in the same vector space, they become comparable. We can apply several algebraic operations between patents and tasks. For example, we can estimate a meaningful distance between every pair of tasks and patents. As Webb used verb-noun pairs, he used subjective judgment to select the final verb-noun pairs. As a result, he could not use the much richer and comprehensive patent abstract data as that would have led to a manifold increase in the complexity of his analysis. Our use of the NLP tool, FastText, allowed us to do these computations more efficiently, thus substituting Webb's painstaking curation efforts with computational power.

CPC prediction

We developed a deep learning model that inputs a task description and assigns 4-digit CPC codes. We trained this model using Google's patents

database. We first computed FastText embedding for every patent. Then, we trained a deep model to predict corresponding CPC patents inclusive of all patent embedding. Our model can predict multiple CPC codes for a patent. This model is trained using over three million patents that include all AI-related patents in the past 15 years and a sample of patents in other areas. In over 90% of the cases, our model predicted the correct CPC code among the top-5 predictions.

We used this CPC classification scheme and applied it to tasks. Given a task from the O*NET database, we computed its FastText embedding and used our CPC classifier to assign CPC codes to the task.

AI score for tasks and jobs

Given a task, our CPC classifier predicted a list of CPC codes along with their probability scores. Some of these CPC codes represent AI-related patents. We added the probabilities for individual AI-related CPC classes to calculate AI scores for a task. We calculated AI scores for nearly 20,000 possible tasks. Similarly, we calculated a weighted average of AI scores for the involved tasks to calculate a final AI score (range 0-1) for the job. We further aggregated these scores at the level of industry sectors in Qatar.

Appendix II: Functioning of AIScore Model

These figures are a depiction of how our model works to determine AIScore for any job.

FINANCIAL ANALYSTS	
SAMPLE TASKS	AI AUGMENTATION POTENTIAL
Percent oral or written reports on general economic trends , individual corporations, and entire industries.	Medium
Evaluate and compare the relative quality of various securities in a given industry.	High
Determine the prices at which securities should be syndicated and offered to the public.	High
Monitor fundamental economic, industrial, and corporate developments by analyzing information for publications.	Very High
Interpret data on price, yield , stability, feature investment-risk trends and economic influences affecting investments.	Very High
Prepare plans of action for investments, using financial analysis .	Very High
Inform investment decisions by analyzing financial info to forecast business, industry, or economic conditions .	Very High
Highlighted keywords or phrases are the ones our AI model would have picked up due to similarity with AI patents and used to determine AI augmentation score.	

Figure 3. Financial Analysts




NURSE PRACTITIONERS	
SAMPLE TASKS	AI AUGMENTATION POTENTIAL
Counsel patients about drug regiments and side effects or interactions with other substances.	Very Low
Knows or treat acute health care problems, such as illnesses, infections, or injuries.	Very Low
Detect and respond to adverse drug reactions, with special attention to vulnerable populations.	Very Low
Consult with, or refer patients to, appropriate specialists when conditions exceed the scope of practice or expertise.	Low
Develop treatment plans , based on the scientific rationale, standards of care, and professional practice guidelines .	Medium
Order , perform, or interpret the results of diagnostic tests, as complete blood counts open (CBSS), EKGs, and X-rays.	High
Keep abreast of regulatory processes and payer systems, such as Medicare, managed Care, or private sources.	Very High
Highlighted keywords or phrases are the ones our AI model would have picked up due to similarity with AI patents and used to determine AI augmentation score.	

Figure 4. Nurse Practitioners

SCHOOL TEACHERS	
SAMPLE TASKS	AI AUGMENTATION POTENTIAL
Attend professional meetings, educational conferences, and teacher training workshops for professional competence.	Very Low
Prepare materials and classrooms for class activities.	Very Low
Plan and supervise class projects , field trips, visit by guest speakers, or other experiential activities, and guide students.	Low
Instruct and monitor students in the use of equipment and materials to prevent injuries and damage.	Low
Prepare and implement remedial programs for students requiring extra help.	Medium
Maintaining accurate and complete student records as required by laws, district policies, and administrative regulations.	High
Prepare reports on students and activities as required by administration .	Very High
Highlighted keywords or phrases are the ones our AI model would have picked up due to similarity with AI patents and used to determine AI augmentation score.	

Figure 5. School Teachers

Appendix III: Examples of Reimagined AI-augmented Jobs

INTERNAL SECURITY	
	Provide the real-time situational awareness to identify potential threats before they get to realized.
	Automatically monitor all activities and social media, broadcast media, security cameras, messages and transaction data.
	When alerted, human experts can verify if that threat is real.
	Co-learning with human experts, the system keeps improving its accuracy and humans can focus on the unusual outliers.
	Significant time savings due to AI- generated reports.
DATA SECURITY	
	Automatically determine mean if sensitive information is present in documents or images.
	Could be used to control information based on access privileges.
	Identifies privilege information from point of file upload, a chat or email.
	Can send alerts in case of a breach.
PROCUREMENT	
	Build and maintain a database of all relevant products by automatically crawling through different documents including product brochures, webpages, emails, and documents.
	Automatically billed list of requirements from email and submitted documents.
	Procurement officer reviews and okays it.
	Recommend the best product matches optimized for cost, timeliness and service based on the vendor histories.
	Automatically create a tender documents to be reviewed and ready to invite bids with the click of a button.