

RESEARCH PROPOSAL

How might developments in artificial intelligence change the nature of the work carried out by corporate accountants?

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1. Background and Rationale

Accelerating from the 1980s as networked PC technology became ubiquitous, information technology has transformed the way accounting transactions are recorded and processed. Accounting and enterprise resource planning applications, combined with tools such as reporting, analytics and spreadsheet applications have transformed the way decision-support is performed by corporate accountants. However, accountants largely provided the expertise to make financial management decisions supported by these tools.

Artificial Intelligence (AI) technology can disrupt this position with systems capable of intelligent behaviour to make financial management decisions far beyond the current scope of systems handling transaction processing and facilitating decision support.

Frey and Osborne (2013) analysed 702 occupations and found that for accountants and auditors there was a 0.94 probability (1 being almost certainty) that their work could be automated by evolving AI technologies. This probability is higher than that for taxi drivers estimated at 0.89 with the onset of driverless cars. Manyika et al (2013) estimate that up to 27% of total global employment costs for knowledge workers such as accountants could be impacted by AI. In audit, automated evidence-gathering and intelligent analytics across large data populations looking for exceptions rather than previously by limited human selection is already here (Bell, 2017).

This research aims to evaluate how Frey and Osborne’s prediction might be realised and what influence the adoption of these emerging technologies might have on the role of accountants from the current point of view of those who could be most affected: accountants themselves.

The organisational background is that AI technologies present both threats and opportunities for corporate accountants, organisations and stakeholders (Jariwala, 2015):

Opportunities	Threats
<ul style="list-style-type: none"> • Productivity may increase as cognitive tasks are automated. • Expert time is released for tasks requiring more expertise. • Improved quality and speed of decision-making where logic and reasoning can be more consistently applied. • Reduced cost. • Competitive advantage for adopters. • Information asymmetry is improved within organisations. • Stakeholder and society benefits through wider access to accounting expertise. 	<ul style="list-style-type: none"> • Loss of jobs as skilled accountants are replaced by systems capable of performing financial management and decision-making tasks. • Loss of human expertise. • The absence of human factors such as instinct, creativity and intuition in making decisions. • AI systems are less effective than human experts and make invalid decisions which may not always be apparent. • Societal impacts of technology and machines ‘taking over’ from humans.

The study will seek to understand and anticipate the potential impacts of AI on the role of accountants and contribute to:

- More informed adoption and planning for new technologies.
- Anticipate the opportunities and threats and the human/non-technical factors which can inhibit technology adoption (Cooper & Zmund, 1990)
- Prepare accountants for the changes which are likely to happen and help anticipate how skills might need to change.

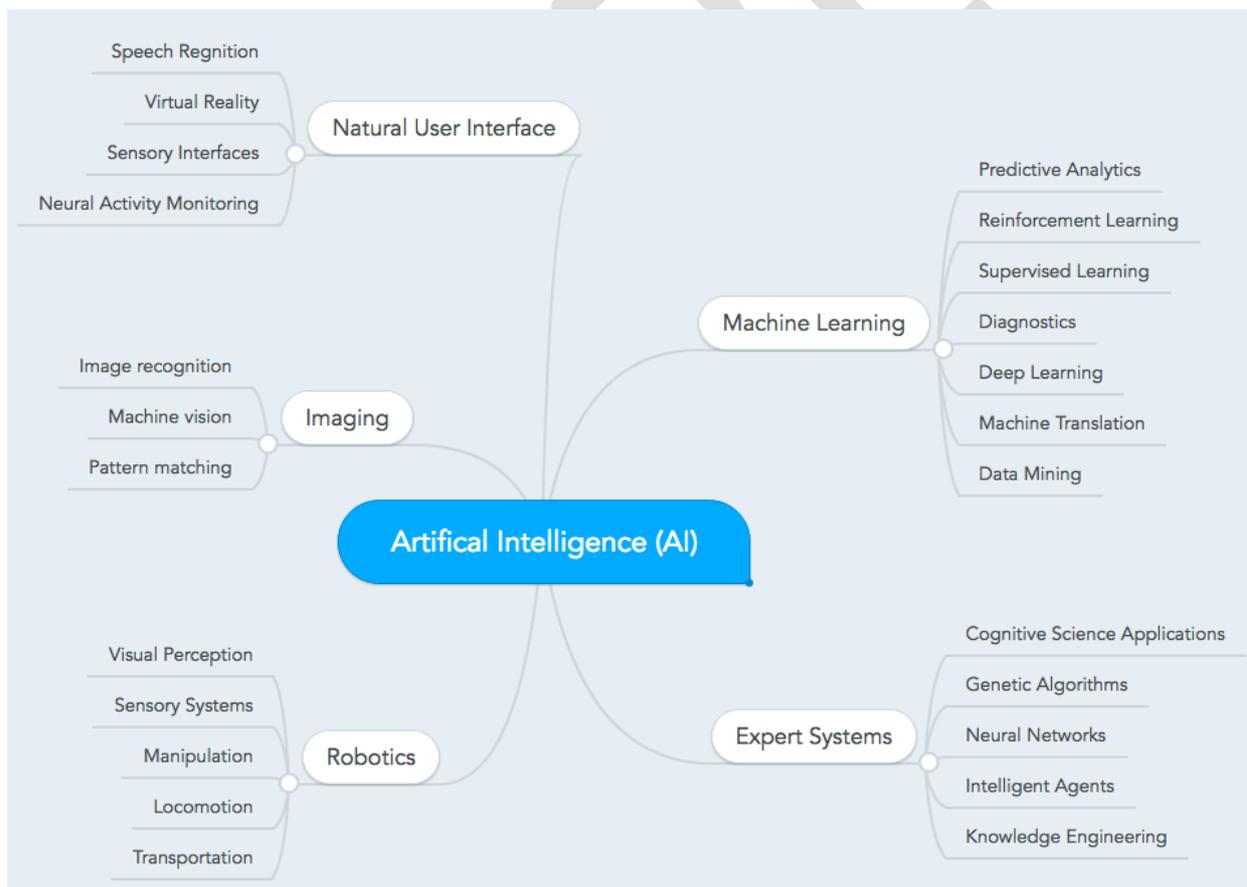
For the research to be manageable, some limitations on scope have necessarily been set:

- The study will be limited to the role of corporate accountants involved in financial management and leadership in organisations. The study is not intended to include the specific work of accountants in public practice, auditors or those in advisory/consultancy roles. However opinions from a population of all UK professional accountants will be sought.
- The views of other professionals, users of financial statements, investors, banks, regulators, and policy makers are outside of scope for this review, potentially for further study.

It is conceivable that some accountants will be negatively predisposed towards new technology which can change their role. This research will help to understand that view if it is identifiable.

Literature Review

AI is an umbrella term originating in the 1950s with the emergence of programmable computers to describe technologies which aim to imitate or reproduce human thinking (Dilworth, 1988). McCarthy (2007) defines AI as the science and engineering of intelligent machines. In this context, intelligence tends to be characterised as human intelligence and the cognitive reasoning that occurs in humans to perceive, analyse and react to arrive at a decision, goal or action. Using the work of Russell et al (2010) an initial scoping of AI technologies is summarised below:



Two branches of AI emerge which are relevant to the work of accountants:

- Machine learning: systems which can act based on algorithms that learn from and make conclusions from data. The same technology is behind autonomous vehicles.
- Expert Systems: which emulate the judgement and decision-making behaviour of humans.

Studies have theorised on how these technologies might apply to the workplace.

Autor, et al. (2003) distinguish between workplace tasks as follows:

Automating Jobs	Routine Tasks: Easier to automate	Non-Routine Tasks: Harder to automate
Manual/Physical	Picking, sorting, assembly	Cleaning, driving, caring
Analytical & Interactive knowledge work (cognitive)	Calculating, recordkeeping, transaction processing	Problem-solving, diagnosis, forming and testing hypothesis, managing, persuading, creating and design.

The last box in this matrix (highlighted) is the domain of corporate accountants: non-routine analytical work involving complex cognitive synthesis and problem-solving which it is the goal of AI to automate.

As technology has historically taken over routine tasks, labour has been able to adapt and acquire new skills supported by education to seek opportunity in more cognitive areas of work. Goldin and Katz (2007) describe a race through the 20th century between education and technology as employment in traditional industries declined, requiring workers to deploy their effort elsewhere by re-skilling or accepting lower pay.

Proponents of AI see an idealistic world built on 20th century progress where AI might diminish some jobs but may create others. Jobs like corporate accountants might change because of AI adoption but through adaptation, assimilation and acquisition of new skills, the accounting profession won't be replaced.

However, in anticipating the extent and pace of technology-driven change in the workplace, Frey and Osborne (2013) observe that:

- Innovations which reduce labour costs may only be introduced if labour is scarce at an acceptable price for employers or the cost of the capital is relatively high.
- Politics and regulation can stand in the way of change, particularly in an area like accounting where regulation and standards drive conservative thinking.
- Making predictions about the adoption of technology, and AI particularly, is especially challenging. Armstrong and Sotala (2012) find that there are strong grounds empirically for significantly increasing the uncertainty in any AI forecast.

What emerges from the literature review is that compared with previous waves of innovation - agrarian, industrial, technical and scientific, information and communications - the next wave driven by AI technologies could be unlike any other in terms of predictability and outcomes. Brynjolfsson and McAfee (2011) for example are pro-technology and are optimistic that technology (AI, systems and networks) will improve quality of life and living standards. In employment, they see advancing technology and 'machines' as allies rather than adversaries. However Beaudry et al (2013) show that a decline in demand for human cognitive skills brought about by the introduction of intelligent systems started as early as 2000.

The literature shows that there is no certainty that new technology will boost productivity in anticipated ways. Pew Research Center (2014) show that there are deep divisions among technology experts surveyed on how advances in AI will impact on employment in the next 10 years between:

- those who envisage AI displacing both blue-collar (manual) and white collar (professional) jobs with increased income inequality, unemployment and social problems, and
- those who also envisage AI taking over non-routine jobs but who also see the creation of new jobs and industries as has occurred historically, search engine optimisation experts being an example.

In contrast, Gordon (2016) suggests that recent innovation is unlikely to be as transformative as the major leaps in technology in the 20th century such as electrification, cars and telecommunications which brought about rapid growth in

output and productivity. He refers to current techno-optimists who he believes have a misguided belief that AI will drive future productivity growth to the same extent. A general survey of accountants' attitudes to technology change from 2012/13 (ACCA) is somewhat out of date in a fast-evolving field.

It is with this background of inconsistent signals from the existing literature, that this research proposal will aim to evaluate the potential impact of AI on the future role of corporate accountants in the workplace by focusing specifically on the views within the profession and the nature of the tasks and work carried out by accountants.

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2. Aims and Objectives

This study has the following aims:

1. To establish the characteristics and classification of work carried out by corporate accountants in non-routine areas.
2. To postulate, using opinions from accountants, on how the capabilities of AI might, in the foreseeable future, automate this work and the cognitive outputs which have hitherto been the domain corporate accountants.

In support of these aims, the objectives are to:

- Summarise information on the current state and direction of AI, machine learning and expert systems oriented towards cognitive applications in the accounting workplace.
- Collect data from corporate accountants and secondary sources to establish the nature and volume of non-routine work carried out by accountants.
- Collect quantitative data from accountants on how they view the likely impact of AI in the foreseeable future on these non-routine tasks.
- Collect qualitative data from accountants in focus groups on the potential impacts of AI on the profession, and attitudes toward technology adoption.
- Identify any correlations between the data using techniques such as triangulation to establish representative views from the accounting profession on the adoption and impact of AI.

3. Method and Design

Philosophy & Approach

The research philosophy will follow an interpretivist paradigm with an inductive approach. Saunders et al (2012) observe that the social dimension to business and management makes it inappropriate to try to apply 'laws' as would be relevant for physical sciences. In this study accountants and other stakeholders are considered social actors drawing on interpretations and perceptions in their professional world. Hence the interpretivist philosophy is appropriate rather than a positivist paradigm. A positivist approach would require an "observable social reality" (Remenyi, 1998) in this case, on technology adoption in the future which is clearly not observable now.

An inductive research approach is appropriate since there is no strong theoretical position on which to base the collection of data. AI is an evolving technology and the future impacts on the accounting profession are unknown. Work such as Frey & Osborne has sought to estimate the impact in a general sense but not in a way which is specific to the accounting profession. Collection and analysis of data, relationship with relevant existing literature and drawing conclusions specific to the accounting profession is intended to achieve the research aims (Robson, 2002).

Strategy

The research will utilise a combination of two strategies:

- **Survey:** A survey will ask accountants to consider the possibility of non-routine accounting tasks being automated by AI over 10 year and 25 year timeframes. The survey will also gather information on the work time

allocation across these non-routine accounting tasks. This will yield data from a valid population standardised and in an economic way (Saunders et al).

- **Grounded theory:** will be used to build conclusions through induction from focus groups on the impacts, opportunities, and threats that may arise from the adoption of AI. Grounded theory, based on Glaser & Strauss (1973), will be used to postulate how AI could impact on the work of accountants by developing understanding “grounded” in systematic quantitative and qualitative data analysis collected from the survey and the focus groups. Grounded theory is appropriate to explain what might happen through technology-related change in a social setting where there is no existing hypothesis.

Other research strategies were considered but rejected:

- Experiment: the study is focused on future developments and attitudes and so trying to establish a specific causal link would be inappropriate.
- Case study: There are examples of AI take-up impacting other professions eg radiologists but these are not considered directly relevant to the non-routine work carried out by accountants.
- Action research: this strategy was considered as it does have iterative and inductive relevance. However, action research has a participatory dimension in which researchers and practitioners act together which is not felt relevant to this study.

In relation to Grounded theory, Suddaby (2006) highlights risks that it must not lack rigour and cannot disguise the lack of a valid methodology. This is addressed below.

Data Collection and Analysis

The research method will follow a mixed method approach which is suggested for business and management research (Curran & Blackburn, 2001) as providing insight into complex business dynamics. The combination of quantitative and qualitative data and primary and secondary sources will ensure the validity, reliability and generalisability of the research data (Saunders et al).

The study will be cross-sectional as it relates to a snapshot in time rather than a longitudinal study over time. This is compatible with the survey strategy and interviews over a short period of time (Easterby-Smith et al, 2008)

Data collected will be as follows:

Primary data (new data)	Secondary Data (existing data)
<ol style="list-style-type: none"> 1. Survey results from the questionnaire. 2. Focus group interviews. 	<ol style="list-style-type: none"> 1. Existing literature on AI and its adoption, particularly in the accounting workplace. 2. O*NET Database 3. Online sources

Firstly, to collect quantitative primary data using a survey:

- A questionnaire will be designed setting out the major task areas typically undertaken by corporate accountants. This will be compiled using the O*NET database, pilot interviews with 5 accountants lasting approximately 1 hour and my own experience gained over 20 years. Questionnaire participants will be given a briefing on the research and relevant background to AI technology in the workplace.
- Background demographic information such as age, experience, job role, income and gender will also be collected.
- Against each of these tasks, accountants will be asked to judge the likelihood of the task being automated by AI using a Likert-type scale over 10 and 25 years. The latter is an accepted period of generation time and both are reasonable periods for currently experimental technologies to reach fruition in an imaginable way. The questionnaire will use a Likert and Likert-type scales commonly used to assess attitude (Boone & Boone, 2012). It will also collect information on the significance of these tasks in terms of time consumed currently.
- The predictive dimension of the questionnaire will be based on an acknowledged approach to considering futures described by Voros (2005): probable, possible, and plausible.

Example questions are shown in the appendix.

Boone & Boone suggest a median or mode (not a mean) approach to analysing this Likert and Likert-type data. Non-parametric analysis such as Chi-squared using Excel will be used to assess the ordinal properties of the responses, the most probable, least possible for example, most time-consuming currently, with analysis demographically in addition. Parametric analysis is not appropriate as the distribution of the responses is not normal. Jamieson (2004) cautions on using a numeric ordinal scale to measure these intervals as being equidistant.

Secondly, focus groups will be used to collect qualitative primary data as follows:

- The same pilot interviews to inform the survey, combined with secondary research and the literature review will be used to prepare for and structure the focus group sessions.
- Again, focus group participants will be given a briefing on the research and relevant background to AI technology in the workplace.
- The estimated duration of the group meetings will be 1.5 - 2 hours. The groups will be moderated by one researcher. A second researcher will observe and both will take notes. An audio recording will be made with the participants' permission.
- All focus groups will be face-to face. Saunders et al highlight the shortcomings of telephone and synchronous electronic interviews that simultaneous note-taking is difficult, observation is restricted and reliability may be reduced.
- Five groups of 5-8 accountants will form the focus groups. This is based on the suggestion of Casey & Kruger (2000) for three or four focus groups of similar participants. If after four sessions, no new themes are emerging then it is likely that a valid range of ideas and data has have been captured.

- At the meetings, participants will be asked a series of open questions in a semi-structured way allowing emerging themes and issues to be explored as they emerge (Saunders et al).

Example questions are shown in the appendix.

The quantitative data will be analysed after the focus groups meet to avoid any bias or impairment of validity in preparing the questions for the groups. Consistent with grounded theory, focus group notes and transcripts will be codified and categorised to identify tags and units of data, indexed in an organised way. Memoing will summarise the patterns and themes emerging from the codified data until no new themes emerge. NVivo software will be used for the qualitative analysis as it can help structure this process, categorise and identify patterns.

In combining the qualitative and quantitative data and mixed methods, the ideas of Denzin (1978) and triangulation will be relevant to improve the validity and credibility conclusions from of the data. Triangulation seeks convergence of results from the different methods to overcome the weaknesses of any single method. The analysis will use what Tashakkori and Teddlie (1998) describe as 'quantitizing' and 'qualitizing' to transform qualitative data into quantitative data and converting quantitative data to qualitative data to support triangulation.

In relation to secondary data, a starting point for the questionnaire will be O*NET OnLine, a US Government-sponsored database which codifies work activities, skills, and experience for over 700 occupations including accountants. The same data was

used by Frey and Osborne (2013) generically across all occupations but not precisely focused on the work of accountants.

Setting and Access

The research will take place among UK-based accountants. It is considered that the work of accountants is relatively consistent internationally and the technology availability would be no different across developed economies.

Access to accountants may be problematic because of time commitments and unwillingness to engage in the research. The following strategies will be used to gain access:

- Contacting the UK accounting professional bodies to identify research participants among their membership.
- Establish credibility with an introductory letter and a copy of this research proposal with an executive summary/abstract added so participants are clear on the purpose.
- Sharing the findings of the research with participating organisations and participants by holding a briefing presentation and sharing the report.
- Ensuring effective use of participants' time through effectively designed questionnaires and interviews.
- Allowing time and making convenient arrangements for participants.
- Ensuring confidentiality and sensitivity.

Using social networks such as LinkedIn to identify and select samples of accountants was considered but the risk of bias increases.

Sampling Strategy

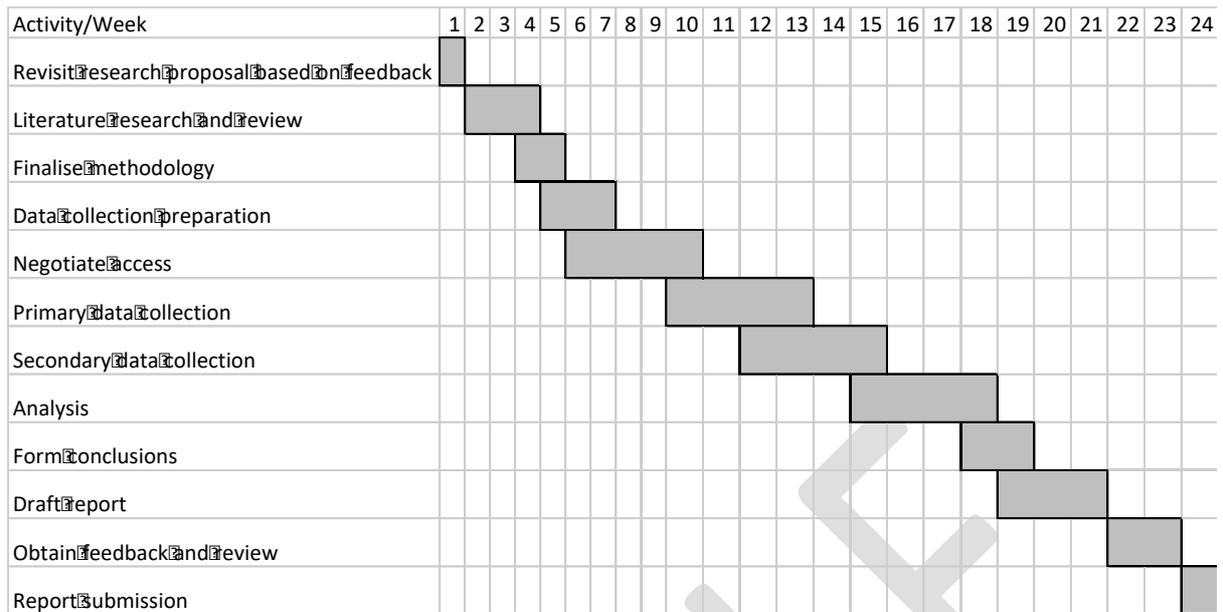
The sampling strategy for the primary data is summarised in the table below:

	Survey: Quantitative	Focus Groups: Qualitative
Population	UK Professionally qualified accountants currently registered with a recognised professional body	
Sampling frame	250 Professionally qualified accountants A 20% response rate is assumed	250 Professionally qualified accountants A 20% willingness to participate assumed
Sample size	50 objective 30 minimum	5 Groups each comprising: 5-8 accountants 30 minimum in total
Sampling technique	Probability sampling: Simple random sampling	Non-probability Purposive sampling

Professionally qualified (CCAB/CIMA) accountants are the key group that may be affected professionally and economically by the application of AI to their work and are well-placed to express a valid opinion on AI take-up. Probability sampling for the quantitative data will yield a conclusion representative of the population. Purposive sampling for the qualitative study will select sample units for example for experience, and job role to ensure a cross-section of sample units to stimulate debate in the focus groups (Teddlie & Yu, 2007).

Timeline & Resources

This Gantt chart shows the expected timeline for the research:



Resource implications of the research to be addresses include costs for the survey (printing, postage), facilities for interviews, materials and tools.

Ethical Issues

The study will comply with UCL's Code of Conduct for Research, ACCA's Code of Ethics and legal requirements such as the Data Protection Act 1998.

The research is sensitive, involving information and views on potential changes to employment. This could have detrimental consequences for individuals or groups. During interviews, it is possible that sensitive commercial information could be revealed. Therefore consent, confidentiality, privacy and sensitivity will be addressed.

For primary data, consent will be obtained from participants through a consent form and a written brief which sets out the objectives, methods, time commitment, potential outcomes, ethical standards and any risks of the research. It is considered initially that the secondary sources referred to are not likely to create a need for specific consent but will be acknowledged. All data will be stored securely to ensure the confidentiality and anonymity of participants. It will remain the property of the researcher and will not be shared or divulged.

If any ethical difficulties arise, the researcher will try to resolve these with reasonable judgement but with reference to the Course Tutor if appropriate.

The published research findings will not refer to data from a participant who could be identified unintentionally.

Appendix

1. Example survey question for quantitative analysis

Instructions: For each question please tick your view on the likelihood:

<i>Within 10 years do you think AI technologies could fully automate ...</i>	Not at all Impossible	To a small extent Plausible	To some extent Possible	To a moderate extent More possible	To a large extent Probable
<i>the sensitivity analysis of a complex financial model?</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>the production of detailed narrative commentary to financial statements?</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>complex departmental budgeting and consolidation</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Instructions: For each statement please tick your response:

<i>The following tasks take-up a significant part of my time:</i>	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
<i>Preparing financial statements</i>	<input type="checkbox"/>				
<i>Interpreting financial statements</i>	<input type="checkbox"/>				
<i>Building financial models</i>	<input type="checkbox"/>				
<i>Creating financial solutions to organisational challenges and opportunities.</i>	<input type="checkbox"/>				

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
<i>In my everyday life I am an early adopter of new technology</i>	<input type="checkbox"/>				

Further questions are to be developed during the research project.

2. Example focus group questions for qualitative analysis

- *How do you react to the idea of AI having an increasing role in the work of corporate accountants?*
- *What tasks that you perform regularly do you think could be automated by AI in the foreseeable future?*
- *What tasks do you think could never be automated?*
- *What do you see as some of the threats to the role of corporate accountants from this technology?*
- *What do you see as some of the opportunities and benefits that might arise?*

Further questions are to be developed during the research project.

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