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## Crime in the AEC-industry: Opportunity space for the quality assurer

Arnfinn Øversveen<sup>a,\*</sup>, Ola Lædre<sup>a</sup>, Jardar Lohne<sup>a</sup>

<sup>a</sup>Norwegian University of Science and technology (NTNU), Høgskoleringen 7A N-7491, Trondheim, Norway

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### Abstract

The literature recognizes criminal behavior in the architecture, engineering and construction (AEC) industry as a growing problem that needs to be addressed. The purpose of this study is to identify the opportunity space a quality assurer (QA) has to commit work-related crime within Norwegian construction projects. The analysis focuses on the role in general and not individuals. Despite this, the methodological basis is based on a specific case. The project chosen can be representative of other Norwegian building and construction projects, and the insight are relevant to other contexts. The primary data is obtained through nine semi-structured in-depth interviews with key figures within the industry. Furthermore, a literature search has been carried out to identify knowledge gaps. The results identifies an opportunity space in a number of processes in which the QA is responsible. The QA has significant influence within projects and has the opportunity to manipulate the QA-systems to his advantage. Furthermore, there is little experience amongst the interviewees with this opportunity being exploited. The results from this study and published data support that a third-party control, distancing of bonuses and stricter sanctions will be the most effective measures. However, there are few comprehensive reviews of this research field to date. It seems that little research has been published on the topic of what opportunity space there is for a QA within AEC-industry. The article will help to identify discrepancies, knowledge gaps, deficiencies in routines, systems, controls and etc. Furthermore, the article can be used to improve the overall quality assurance.

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\* Corresponding author. Tel.: +47 91590901.

E-mail address: [arnfinnoversveen@gmail.com](mailto:arnfinnoversveen@gmail.com)

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## 1. Introduction

The AEC-industry is one of the largest sectors in the world [16]. The industry suffers from criminal activity all over the world and is identified as one of the most criminal sectors (e.g. [12,17,4]). After the EU enlargement to Central and Eastern Europe in the period between 2004 and 2007, work-related crime has increased in Norway [28]. The EU expansion enabled free movement of labor and services, and Norwegian businesses faced sudden competition [24]. This kind of activity has a huge impact on the society. In recent years, the industry's reputation has been weakened in Norway, following reports of scamming and trickery [24], widespread tax manipulation [8], fraud against the public sector taking place on a large scale [10] and people working under indecent conditions [28].

In recent years, the perceived increase in criminal behavior has caused considerable interest within the community. The industry has seen significant advances in the fight against work-related crime. The Norwegian government has developed several work-related crime centers with an aim to strengthen coordination of efforts [23]. The increase of attention can also be seen in the number of publications (e.g. [18]). Research in the field of organizational issues has been of great interest with a growing activity. The research of this tend to focus on the role of the project manager, despite an industry with a number of other important roles.

Construction projects can be particularly difficult to manage because of complex supply chains [9]. This complexity generates a markable vulnerability for work-related crime within the industry [24]. The literature emphasizes that all figures within the supply chain can potentially benefit from criminal behavior in the AEC-industry [19]. The QA-manager is supposed to ensure that all activity is carried out in accordance with the quality required by the contracts. Therefore, the study focuses on control systems used for quality assurance. Despite this pivotal role of a QA, the opportunity space of a QA to commit work-related crime has yet to be established. With "opportunity space" we in the following understand not only actual offenses committed, but the possibility of committing offenses for profit. In order to address these overall challenges, the following research questions are addressed:

- (1) What opportunity space does a quality assurer have for committing work-related crime?
- (2) What is the experience of the quality assurer utilizing this opportunity space?
- (3) What measures can be implemented to prevent work-related crime?

Although an extensive literature search is carried within the international research literature, this article focuses on specific challenges in the Norwegian context. The research does not cover all the processes a QA is involved in, but focus primarily on deviation management. The research of this paper is case-specific and limited to the Norwegian AEC-industry, yet, research presented can also be used in other contexts. This paper is organized as follows: in section 2 we present the theoretical framework, in section 3 we present the methodological approach, in section 4 we present the results, in section 5 we discuss of the results in light of the theory and lastly in section 6 we present the conclusion.

## 2. Theoretical framework

A trademark of work-related crime is the violation of laws and regulations when using work labor [20]. The term *work-related crime* is difficult to define due to a variety of definitions. Most figures in the fight against work-related crime have now adopted the government set-term. Here, work-related crime is defined as: "*acts that breaches with the Norwegian laws concerning wages, working conditions, welfare, taxes and fees, often done organized, that exploits workers or appears to be anti-competitive and undermines the social structure.*" [23] (our translation).

The AEC-industry is plagued by crime worldwide. Criminal figures utilize the systems to their own benefit and does so with considerable diversity. It is generally acknowledged that there are significant dark numbers needing to be addressed [18]. The two most common forms of work-related crime in the Norwegian AEC-industry are 1) exploitation of foreign workers, and 2) evasion of taxes and fees [20].

The AEC-industry has been identified as the sector with most corruption and almost all phases of construction projects have become problem areas (e.g. [7, 32, 4]). The substantial size of the sector in combination with unethical

performance will impact society deeply. It is an impediment for economic development and good governance (e.g. [21, 23]). A recent report shows that the turnover of the Norwegian AEC-industry in 2016 was as high as NOK 437.3 billion [29]. Of this Eggen et al. [8] reported that approximately NOK 28 billion is lost to crime each year.

It is challenging to uncover the nature and exact extent of the crimes, and who benefit [23]. In addition, it is also challenging for complex organizations to identify and prove who was responsible for what, especially for outsiders, and it can therefore be easy to put morality aside [30]. According to Coady [6] one will compromise for the benefit of their own or the company's survival. These actions are often carried out with the best intentions [6]. Furthermore, the literature addresses that poor professional ethical standards is a main reason for criminal behavior [22].

Lohne et al. [18] maintain that most actors within the supply chain profit from criminal activity. Most prominently, those who profit from criminal activity are mainly found in influential decision-making positions. These are figures such as owners, contractors and subcontractors that all tend to benefit directly by increasing flexibility and lowering cost. Secondly, crime in the AEC-industry usually benefits figures who are situated early in the process.

Criminal networks are constantly changing their methods as they find new opportunities for profit, and continuously adapt to the authorities' control activities [20]. The literature also reveals that industry professionals have the opportunity to act either as gatekeepers or as inside men. Inside men is where a person gets a job in a company, preferably in an influential position. This person works for a criminal figure and exploits the systems criminally for their own gain by using the person they have on the inside. This gives a situation with low risk and high reward for carrying out criminal activities.

From 2014 to date, the Norwegian government has worked purposefully towards “a working-society free of crime” [23]. They have established a comprehensive and systematic collaboration between a number of public authorities. This in the effort to prevent and combat work-related crime at international, national, regional, and local levels. Most notably, seven work-related crime centers have been founded [23].

Lohne et al. [18] conducted a literature review on crime in the AEC-industry. The study addressed the entirety of research within work-related crime, the subject matter and uncovered where the research was deficient. The research is based on the topics of organizational, health, safety, environment (HSE) and materials. Briefly summarized, 66% of the research is carried out within organizational subject matter. The literature unveils an increasing occurrence of counterfeit materials and research (e.g. [9, 15, 13]). Furthermore, the literature focuses on the project manager's role (e.g. [3, 5, 25, 13]).

However, there seems to be little research carried out on the subject of the QA, despite their influence within projects. Sichombo et al. [27] reports the need for technical auditing as one approach of combating unethical practices in the Zambian construction industry. The literature also reports of an increasing use of third-party control of the projects [27, 15, 28]. To ensure high quality deliveries and prevent unethical practices, most Norwegian projects have their own QA-manager. A QA-manager is usually responsible for taking care of the company's quality control processes to achieve that a product or service meet the requirements for quality. The QA works with planned and systematic activities in compliance with the company's rules and any other applicable laws [14]. In other words, the QA is included in the work and processes that counteract work-related crime. Taken together, it is clear that a greater understanding of the scope of opportunity a QA has in the projects is necessary. Hence this paper investigates the opportunity space in an effort to combat work-related crime.

### 3. Methodology

A scoping literature review was conducted according to the principles of Arksey and O'Malley [1]. Due to limited amount of literature identified, a case study was conducted as this is particularly suitable for exploratory studies [31]. The case study was chosen as the project has a typical organization that reflects the majority of other construction projects in Norway, allowing for generalization. A document study was conducted by skimming (superficial examination), reading (thorough examination), and interpretation of documents following the prescriptions of Bowen [2].

In total, nine semi-structured interviews were conducted, in accordance to the prescriptions of Yin [31], with durations varying from 30 to 90 minutes with the opportunity for follow-up questions. An interview guide was sent to the interviewees in advance. The interviewees were selected in accordance with recommendations from Flyvbjerg [11] and are key figures within the industry. All interviewees were sent a report from the interview for approval. The

number was not determined in advance of the study, but determined based on the experience of data saturation according to the recommendation from Saunders et al. [26].

As mentioned, this paper focuses on questions which are characteristic to the Norwegian context. It does not address other roles than the role of a QA. The research does not cover all the processes a QA is involved in, but deviation management in its entirety.

## 4. Results

The case of interest deals with one of Norway's largest contractors and one of their projects. To understand the opportunity space, it is necessary to address which systems and softwares the company uses for deviation handling. As of 2021, the company primarily uses Dalux for deviation management, but they are currently in the process of replacing this with its successor, known as Scaled Robotics. This is a software that automates a number of processes which followingly eliminates the need for human involvement. To expand on this change of software, the process is divided into three phases. How Dalux, the former system operates (Phase 1); the intermittent phase where both softwares are in use (Phase 2); and lastly how the new system, Scaled robotics operates (Phase 3). The company's previous system (Dalux) and how it operates is illustrated in Figure 1.

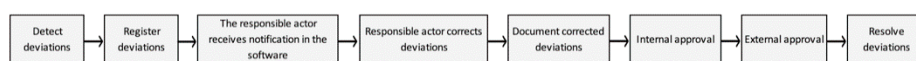


Fig. 1. Deviation process with Dalux

The deviation process with Dalux works by physically detecting an error or a deviation visually, followed by manual registration. The deviation is registered and marked with the performing figure who is then responsible for rectifying this. The figure can correct the deviation and documents this by the use of photos and/or text. Thereafter it requires a two-stage approval. The subcontractor's own quality assurance manager approves that the deviation has been rectified. Furthermore, an external inspector from the main contractor will then inspect the deviation and possibly approve and cease the deviation. The company now works intermittently with the overlapping systems Scaled robotics and Dalux. This is illustrated in Figure 2.



Fig. 2. Deviation process with Dalux and Scaled Robotics

The main contractor now uses Scaled Robotics for manual scanning of buildings with laser scanners. The measurements are processed and forms a 3D model of the actual building. This model is synchronized with the projected model and finds everything that differs with this model. It is therefore important that the projected model is updated to prevent generating unnecessary work. As of now, one must physically go through all the deviations in the software and evaluate these. With scaled robotics it is no longer possible to report any deviations in the software. You would need to generate a report independently of the software to report additional deviations. With the overlapping systems additional rapports can be manually registered in Dalux. Figure 3 is portraying the company's future operating system, exclusively Scaled Robotics.

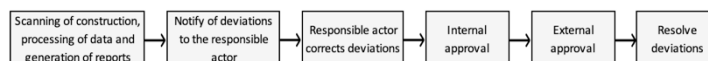


Fig. 3. Deviation process in near future with Scaled Robotics

Scaled Robotics is an immature software in the sense that it is new and not fully developed. The plan is for the software to be able to scan the buildings itself using robot technology that is self-driven, either by using a grounded vehicle or a drone. Thereafter, measurements ought to be sent directly to a server that forms the 3D model of the building, synchronized with the projected model. If the software detects dissimilarities, these will be reported if the deviation is greater than a set margin of error (set in quality assurance documents contracted). As a result, there are

less people and steps in this process. With Scaled Robotics, the main contractor will automate several processes and thereby reduce resources related to deviation handling.

#### 4.1 What opportunity space does a quality assurer have for committing work-related crime?

Within the deviation handling, the QA operates tasks that concern documents, checklists, quality assurance of finished products etc. All nine interviewees identified an opportunity space for deviation management to commit work-related crime in projects. It is possible to categorize these into two main groups by whether it is passively or actively executed. Active actions are physically carried out, whilst passive actions consist in overlooking deviations found or rather just "closes one's eyes". The latter is often incentivized by easing the workload, but can also lead to profit for the culpable. Applying this categorization to the case at hand, table 1 shows where the two software's can be bypassed or fooled, as well as the level of risk that the action in question will be detected by the software.

Table 1. Level of risk.

Type of action	Action	Dalux	Scaled Robotics
Active	Counterfeit materials	Low	Low
	Counterfeit Documents	Medium	Low
	Operation with an inside man	Low	Low
	Incorrect reporting of deviations	High	Low
Passive	Failure to report deviations	Medium	Low
	Closure of undone deviation points	Medium	Low
	Guiding of crews away from areas with deviations on safety and quality inspection	Low	Low

The two last columns shows the degree of risk associated with a certain action going unnoticed by the designated software. Low, medium and high indicates the level of risk for each of the actions with the two systems. Low risk indicates that the software is unable to detect if the action in question is performed. As we can see, the systems struggle to detect most of these and it is easier to bypass the automated system, Scaled Robotics.

Active actions, table 1 mentions "operating with an inside man". This is not a direct opportunity for work-related crime, but rather an action that enables a number of possibilities. This is where unethical companies manage to get one of their employees employed within another company that will act as their "inside man". Worst case, the "inside man" will have a number of responsibilities and authorities that can be extremely harmful to the company. The person will then be able to run processes within quality assurance for the benefit of their original company. One of the respondents specified that: "It happens that a received offer is a lot lower than others. They may also even go lower on price. It is quite clear that these contractors want a collaboration with a large sole contractor, but what intentions the contractor has is difficult to map."

All interviewees believed that it was possible to make a profit from criminal acts through forgery of materials or documents. It is emphasized that this could bypass the Dalux-system. This is especially the case if one fails to or incorrectly report errors in agreements with a subcontractor, evading the two-stage approval failsafe. Regardless of this being unethical, this leads to "low risk, high reward"-opportunities. If there is an area where one does not want a further inspection, the QA can make sure that no one inspects this area on the weekly safety and quality inspections. Where in the chain this subcontractor is located is important. One of the respondents exemplified that: "When constructing a firewall, it can be difficult to see what is behind the cladding of a finished wall. It will be possible for a rogue or criminal figure to falsify checklists by documenting that the various control points when building a firewall have been taken care of."

Furthermore, it is explained that counterfeiting of materials will probably be one of the easiest ways to acquire quick money. Especially in areas where other professions have a lack of knowledge, such as pipes, paint/epoxy, membranes, roofing felt, etc. One of the respondents specified that: "I do not expect it to be particularly difficult to forge delivery notes or other approvals on materials. It will also be possible to place counterfeit materials in packaging that does not belong to the material. For example, paint is easy to fill in approved buckets".

#### 4.2 *What is the experience of the quality assurer utilizing this opportunity space?*

Four of the interviewees had experience that the quality assurance system has been exploited through criminal activity for potential rewards. Of these, only two have concerned the QA. The remaining two was where the project manager has utilized the quality assurance system. It is emphasized here that in such cases the person in question has been given the opportunity to resign himself. Despite this, all interviewees agree that there is probably more of this than one might think and they assume high rewards, especially for large projects. There are a number of the previously mentioned opportunities that are characterized by a low risk of being caught. Some of the interviewees uttered phrases like: “Why change a winning team?” and “When the project goes well, why look further into it?”. In this way it appears in several of the interviews that there is possibly little motivation for follow-up of projects that are doing well. One of the interviewees states that: “The quality assurance manager has fairly broad powers in various areas of responsibility and thus has the opportunity to make important decisions. Ethical attitudes are therefore an important area to research”. In these cases, the interviewees believe that all parties are satisfied and it is therefore easy to close their eyes.

#### 4.3 *What measures can be implemented to prevent work-related crime?*

The interviewees explain that the contractor has already introduced measures to help prevent and combat work-related crime. The hiring process with the case-specific contractor contains several courses which the candidate must complete. The courses are carried out during the first weeks of work and cover topics such as crime. In relation to further work with the prevention and combating of work-related crime, the entrepreneur explains that they are constantly working to maintain their values in order to be a role model within the AEC-industry. They are also continuously working to identify and eliminate weaknesses with the quality assurance system to ensure seriousness in the industry. The contractor thinks work-related crime is a topic that is not covered enough through literature or regulatory control in the industry. Furthermore, the contractor proposes that the following measures can be implemented: 1) Distant bonuses that have previously been project-based, 2) Create a system that gives suppliers a score according to the degree of satisfaction, 3) Greater degree of follow-up of the projects and 4) Implement a third-party control of the projects.

### 5. Discussion

In this paper, we set out to address: 1) what opportunity space the QA has to commit work-related crime, 2) what the experience is of the QA utilizing this opportunity space and 3) what measures can be implemented to prevent work-related crime.

It could seem that the interviewees found it difficult to identify opportunities at the beginning of the interviews. In several of the interviews, a problem emerged that seemed to be more common than first thought. It is no secret that the AEC-industry is plagued by crime both nationally and internationally on several levels. It also seemed that the interviewees were aware of this problem, but that it was rather difficult to say anything about the scope. Early in the interviews when the interviewees were asked what opportunity space a QA-manager has to engage in criminal activity, only 5/9 objects answered that there was an opportunity space. However, later in the interviews all candidates managed to identify problems with the system and therefore an opportunity space. Whether this is due to a deeper evaluation of the problem, more openness or that this has not been thought through before is difficult to say. Anyhow, it may seem that work-related crime is a topic that is difficult to talk about. An interesting finding is that all interviewees agreed that it would be possible to acquire a profit through either forgery of materials or documents. Kjesbu et al. [15] also confirms this through her survey. Furthermore, opportunities were identified during the weekly quality and safety inspections and during deviation handling. This was possible both if one was working with an inside man or if one alone wanted to fool the system. In any case, there was a mutual agreement that there was a possibility to profit if one was motivated enough to do so. It also seems like there is an agreement that counterfeit of materials would be the easiest way to gain profit by criminal activities within the AEC-industry both from the literature and the interviews. Regarding possible actions for profit, these were sorted into active and passive actions. The software struggled to detect criminal or unethical conditions. It is therefore not unreasonable to imagine that it is the passive actions that are most relevant as these have little consequence if discovered. This strengthens the idea of low risk, high reward.

There is limited experience with the QA making use of the opportunity space. 4/9 interviewees have experienced that this takes place, but only two of these experience concerns the QA. The interviewees see opportunities at a number of areas. Despite this, there is agreement that the quality assurance system works, as they believe their colleagues are reputable. It may seem that although this system is based on trust, this works well as trust is strengthened through a combination of company culture, employment routines and other systems. At the same time, it is uncertain how many of these potential unethical actions see the light of day. Several of the interviewees emphasize that "it is easy to close your eyes when things are going well". In addition, there is no follow-up of projects reaching its goals.

The measures proposed by the interviewees can be said to be of different suitability. Distancing bonuses can be a good measure, that removing economic intensives reduce motivation seems likely. When it comes to establishing an evaluation system, this is something that is perhaps more demanding, and it is difficult to say anything about the value of this as the risk of being discovered is extremely low. Therefore, a greater degree of follow-up of the projects can be a reasonable proposal in the sense that this can lead to a higher risk of being discovered. In addition, the implementation of a third-party control will help to increase security against unwanted incidents taking place. More frequent checks and implementation of measures are also documented by Skovly et al. [28] as relevant factors in the fight against work-related crime. However, it is easy to get around. There are also reports of self-dismissal of people who have been discovered for crime in the industry. In light of reported measures, it is conceivable that stricter sanctions would be wise if one is discovered to be sensible. At the same time, it will be wise to have a greater commitment from the executive management.

With a large space of opportunity, poor experience of utilizing this room and proposals for measures, it is clear that more research is needed. The literature repeatedly tells from a number of sources that the scope is incredibly difficult to map. It is therefore reasonable to assume that criminal acts are committed both through identified and unidentified spaces of opportunity in this paper. This is especially because several of the interviewees express a lack of motivation to investigate high-profit projects. It is not unreasonable to assume that it is precisely these projects that suffer from criminal acts. On the other hand, it may also be tempting to undertake criminal acts to make up for lost time if the project should otherwise go bad. It may also seem that it requires greater resources if one is to be able to deal with these weaknesses with the QA-system. However, the field will need more research.

## 6. Conclusion

This study shows that it could indeed be possible for a QA in a Norwegian contractor to get around the QA-system through criminal activity. The QA can either act as an inside man for another company or work by himself both for a low risk with high reward. There is agreement that the controls could be bypassed or fooled. The systems struggle to detect most of these and it is easier to bypass the automated system, Scaled Robotics. Early in the interview, the interviewees struggled to identify the opportunity spaces. Despite this, the outcome of the study lead to the conclusion that there exist an opportunity space for the QA to commit work-related crime. However, there is little experience of the opportunity space being exploited, but the interview study still shows cases where this happens. This study support that a third-party control, distancing of bonuses and stricter sanctions are the most effective measures.

These findings indicate that further research into the QAs in Norwegian contractors could be useful. As it seems to be possible that the QAs are acting as inside men, examining the scale of such actions could be a path for further research. It could include a wider search for respondents to validate the findings, researching deeper how the corporate level effects the QAs' decisions. Although this study is case-specific, it can be seen as generalizing for the Norwegian construction industry due to its nature. Through the research, a knowledge gap has been filled through a focus on a smaller area to narrate larger context. Using this study as a basis, a natural next step would be to expand to include more companies. In future work, it may be useful to study particular aspects of discovery risks and consequences.

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