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From Guardian to Bystander

Agency Independence and the FAA's Failed Oversight of Boeing

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Contents

Abstract 3
1. Introduction 5
2. Case description 7
3. Literature review & Theoretical framework 9
3.1 Federal Aviation Administration 9
3.2 Agency Independence 9
3.2 Regulatory Capture 10
3.3 Principal-Agent Problem 12
4. Methodology 14
4.1 Research design 14
4.2 Research methods 14
4.3 Contextualized Expectations 15
Condition A 15
Condition B 16
Condition C 16
Condition D 16
4.4 Operationalization 17
4.5 Data collection and analysis 18
5. Analysis & Results 19
5.1 Timeline and actors 19
5.2 Description of the State of FAA Independence 25
5.2.1 State of Regulatory Independence 25
5.2.2 State of Institutional Independence 26
5.2.3 State of Supervisory Independence 27
5.2.4 State of Budgetary Independence 28
5.3 Regulatory capture and the principal-agent problem 29
5.3.1 Collusion and a lack of congressional power 29
5.3.2 Hiring of officials and the revolving door 30
5.3.3 Over-delegation and information asymmetry 32
5.4 Safety Culture at Boeing 36
6. Conclusion 39
7. Discussion 42
8. References 44

Abstract

This thesis investigates the role of regulatory agency independence in the deterioration of the safety culture at Boeing, which culminated in the crashes of LNI610 and ETH302 involving the Boeing 737 MAX. The research focuses on the FAA and its interactions with Boeing and the US government. Via the four dimensions of agency independence it analyses how agency independence affects the risk of regulatory capture and principal-agent problems and how this affects agency oversight and by extension aviation safety.

A single-case study design was employed, using qualitative secondary data from investigative reports, academic literature, policy documents, and media sources. The study applied Causal Process Tracing (CPT) to analyse the relationships between agency independence and the development of a negative safety culture at Boeing. The FAA's independence was operationalized along four dimensions as defined by Quintyn and Taylor (2002). Evidence was categorized by causal mechanisms and configurations to assess sufficiency for explaining the safety failures.

The analysis showed evidence that three of the four causal configurations could be considered sufficient conditions for regulatory capture and principal-agent problems, and by extension cause a negative safety culture at Boeing which ultimately led to the accidents. The FAA's inadequate state of independence from both government and industry enabled regulatory capture and principal-agent problems which undermined oversight of Boeing by the FAA. The study contributes to existing public administration research through insight into the structural weaknesses of governmental agencies, and how these weaknesses affect an agency's ability to deal with governmental and industrial influence, especially in high-stakes sectors like aviation. The study suggests research into an agency independence framework like the one made by Quintyn & Taylor (2002) but focused on sectors selling physical products which concern the physical health and safety of citizens.

List of abbreviations

AFSCME	American Federation of State, County and Municipal Employees
AIA	Aerospace Industries Association
AIR	Aircraft Certification Service
AOA	Angle of Attack
AR	Authorized Representative
AVS	Aviation Safety Organization
BASOO	Boeing Aviation Safety Oversight Office
CEO	Chief Executive Officer
COO	Chief Operating Officer
CPT	Causal Process Tracing
DOT	Department of Transportation
EICAS	Engine Indicating and Crew Alerting System
ETH	Ethiopian Airlines
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organization
JATR	Joint Authorities Technical Review
LNI	Lion Air
MCAS	Maneuvering Characteristics Augmentation System
NATCA	National Air Traffic Controllers Association
NTSB	National Transportation Safety Board
ODA	Organization Designation Authorization
PASS	Professional Aviation Safety Specialists

1. Introduction

The aircraft manufacturer Boeing is one of the most well known American companies, and can be considered an icon of the aviation industry. Throughout its existence they have designed aircraft that redefined the aviation landscape, such as 707, the first widely used jet aircraft, and the 747, the first widebody aircraft. Boeing was not only known for its achievements in innovation but also its commitment to engineering excellence, and an uncompromising safety culture where no stone was left unturned. The company become synonymous with aviation safety: “If it ain’t Boeing, I’m not going.”

This reputation has come crashing down due to recent events and revelations. Much has been said about what went wrong inside the Boeing company: Two crashes of their newest aircraft variant, the 737 MAX in 2018 and 2019, was the end result of what can only be described as a slow and steady downfall, a disintegration of a once great engineering firm into a mere Wall Street focused business that would put the livelihood of employees to the wayside and risk the lives of passengers for extra quarterly profits. At this point it is well known that the start of the deterioration of Boeings safety culture coincided with the merger with its industrial rival, McDonnell-Douglas, in 1997 (Robison, 2021). The introduction of McDonnell-Douglas executives into the management of Boeing was the driving force behind the change in company philosophy that devalued safety and valued profits over everything else. However in order for tragedies to happen, like those with the 737 MAX, a simple change of management cannot be the sole reason for the downfall of a great company, and it cannot be the sole reason for the tragic sequence of events that led to the loss of 346 lives. From a public administration perspective, the cause of the 737 MAX tragedies can also be traced back to the government, and the agency that was supposed to ‘supervise’ Boeing, and keep the company in check: the Federal Aviation Administration (FAA).

Thus the goal of this master thesis is not to tell a story that has been told countless times. This is a public administration paper, that aims to research the possible role of government agencies in the prevention or lack thereof of private sector company misconduct in order to prevent a major crisis, like an aircraft accident, from happening. The FAA is one such agency, an agency that serves under the US Ministry of Transport and Infrastructure and the US Congress. Its main task is to maintain aviation safety in the US, while at the same time promoting the aviation industry in the US. Aircraft that are built in the US must pass FAA safety standards through certification processes, and actors in the aviation sector must abide by aviation safety legislation executed by the FAA. Judging from the two accidents that happened with Boeing’s brand new aircraft design, it is apparent that the FAA failed in its task to maintain aviation safety on this occasion. The flaw with the Maneuvering Characteristics Augmentation System (MCAS) that spelled the doom of LNI610 and ETH302 should have never gotten through the cracks of the certification process. The FAA, the regulator, the supervisor of Boeing, failed in its task. Investigations into the functioning of the FAA as an agency revealed that the authority of the FAA as a regulator had diminished so far that one could speak of an agency regulated by the industry rather than the other way around (US House Committee on Transportation and

Infrastructure, 2020). This thesis aims to provide more insight into how a failure of public administration could leave a regulatory agency like the FAA powerless.

In a time where citizens question whether governments have their best interests at heart, rather than those of industrial corporations or politicians (Bovend'Eert et al, 2023), this paper aims to give insight into the activity of government agencies, and how distinctly they operate from politics and the free market. The knowledge regarding the position of agencies in the government and in society has never been more societally relevant in a time where the value of governance constantly being questioned. This paper aims to show the role of governance in protecting the rights of citizens. The FAAs duty to citizens is a safe aviation system, the FAAs commitment to its main task is what gives the agency legitimacy, upholding these duties by appropriately supervising Boeing is to serve every person that steps on a Boeing plane every single day. If the citizen acknowledges the FAAs ability to complete its duties, the agency can be considered to be legitimate. This aspect of legitimacy is what makes this research into agency independence societally relevant.

This thesis contributes to the field of public administration by means of providing new insight into what can cause failure of government agencies. The case used for this thesis illustrates why the underlying reasons for government agency failure needs to be explained. In an aviation context, Hoppe (2019) argues that there is a need for a revision of the regulatory system and more regulatory oversight in the aviation industry. This thesis aims to fill this research gap from a public administration perspective by analyzing how agency independence affects regulatory oversight and the role of this in the 737 MAX accidents. To fill this research gap is to uncover the potential weak spots in the governmental systems safety regulators like the FAA are situated in.

The thesis analyses the relationship of regulatory agency independence and the development of a negative safety culture within supervised industrial actors, taking Boeing as an example, taking the accidents with LNI610 and ETH302 as directly related to the negative safety culture at the Boeing company. This is expressed through the following research question:

How did the independence of the FAA as a regulator contribute to the development of a negative safety culture at Boeing that caused the crashes of LNI610 and ETH302?

- How independent is the FAA as a regulator in its interaction with the US Committee on Transportation and Infrastructure, the Ministry of Transport, and Boeing, and how does this explain the role of regulatory capture and the principal-agent problem in the development of the negative safety culture at Boeing?

First of all, the case of the 737 MAX crashes will be thoroughly discussed including a timeline and a description of all the relevant actors, with ample mentioning of what has already been documented in regards to the case. This is followed by an explanation of all the relevant concepts and variables used in the thesis including relevant prior existing research into the concepts. This is followed up by the operationalization of the research methods. The theoretical framework in conjunction with the research methods are used to explain the theoretical expectations of the research. Lastly, the results of the analysis are described, followed up by a discussion of these results and the drawing of conclusions regarding the thesis.

2. Case description

On the 29th of October in 2018, Lion air flight 610 crashed into the sea shortly after take-off from Jakarta Soekarno-Hatta International Airport. 189 people were on board, none of them survived. This monumental tragedy was quickly shrouded in media controversy, first surrounding Lion air's poor safety record, but soon thereafter surrounding the aircraft type and the plane's flight path. The 737 MAX used during the accident flight was brand new, less than 3 months old. The flight path of the accident flight was erratic, showing significant deviations in altitude throughout the flight before a final high speed dive. The day before the accident a different Lion air flight with the same aircraft had a very similar emergency that afterwards was identified to be caused by a faulty Angle of Attack (AOA) sensor that had a 21 degree deviation from the actual AOA of the aircraft. After the Indonesian investigators consulted with Boeing, suspicion quickly arose around a system that up until that point operators and pilots alike had no knowledge about, the MCAS. MCAS was designed to help pilots in situations where the AOA of the aircraft is too high. An AOA that is too high indicates that the angle of the aircraft's wings coming into the oncoming air is too high to maintain sufficient air flow over the wings, which can lead to an aerodynamic stall, in which case the aircraft could fall out of the sky. In situations where the AOA is too high, MCAS is designed to automatically push the nose of the aircraft down through. It does this independently from the inputs of the pilots. Judging from the broken AOA sensor and the erratic flight path of the aircraft, the hypothesis was that MCAS had erroneously activated and pushed the nose of the aircraft down, causing the plane to dive into the sea. Boeing argued that with proper application of existing emergency procedures, the accident would not have happened. Boeing promised to fix the problems with MCAS in the upcoming months and that until that point the checklists would keep crews and passengers safe if a similar problem were to occur again. The 737 MAX was allowed to keep flying.

On the 10th of march 2019 Ethiopian Airlines flight 302 crashed shortly after takeoff from Addis Ababa Bole Airport, killing all 157 people on board. The second crash of a 737 MAX in less than half a year led to a ban on all 737 MAX operations around the world with all continental aviation authorities bar the FAA grounding the aircraft a day after the accident, until more was known about the circumstances of the accident. Once the flight path data of the accident flight was released (showing significant similarities with the Lion Air flight) the FAA also grounded the aircraft, 3 days after the accident. The investigations into both crashes confirmed that both flight crews lost control of their aircraft as a result of the MCAS software reacting to faulty AOA sensor indications by pushing the nose of the aircraft down, leading to a loss of vertical aircraft control. The crucial aspect was that MCAS received its input from just one AOA sensor on the aircraft. If this sensor malfunctioned, there was no backup AOA sensor used that could override the faulty data from the malfunctioning primary AOA sensor. Additionally, despite application of emergency procedures as recommended by Boeing, the Ethiopian crew was unable to regain vertical control of their aircraft after MCAS kicked in. The

737 MAX was grounded from March 2019 until December 2020, when it was recertified by the FAA.[1]

[1] This case description was sourced from the book 'Flying Blind' by Peter Robison (2021)

3. Literature review & Theoretical framework

3.1 Federal Aviation Administration

The general topic of aviation regulation through governmental agencies is discussed by authors such as Downer and Hoppe, who talk about the conflicting interests and ethical issues that come with aviation regulation through governmental agencies such as the FAA. According to Downer (2010), the relationship the FAA has with industrial parties and the government is dictated by what the FAA can and cannot do by itself, Downer explains this through the concept of expertise. When it comes to supervisory tasks in a technical sphere, such as aircraft certification, a lot of technical expertise is needed from the regulator in order to supervise the industrial parties all by themselves. Downer argues it is difficult for a regulator to have this kind of expertise, which is why according to him it is necessary to delegate responsibility for safety to some extent to the industrial parties themselves. Downer's argument is that this creates a dilemma whether to prioritize closeness of supervision or to create more distance as to prevent knowledge barriers from interfering with the supervision of the industrial party (Downer, 2010). Hoppe's work on ethical issues in aviation, specifically her work on regulatory capture in aviation, focuses on how the relationship between the regulator and the regulated in the aviation sector evolves from simply cooperation into collusion and thus regulatory capture, and how a governments approach to policy-making contributes to this evolution. Its general message is the role of the relationships between the regulator, regulated, and the government on the effectiveness of aviation regulatory agencies such as the FAA (Hoppe, 2019). The functioning of the FAA is brought up in a study by Nunn (2020), who emphasizes the role of delegation in the 737 MAX accidents. The study of Nunn (2020) echoes both the inherent need for delegation as described by Downer (2010), but also how the mismanagement of this delegation can lead to safety issues that led to the accidents in a similar manner to the shift from cooperation to capture as described by Hoppe (2019). Nunn's (2020) paper aims to add to the existing knowledge on the functioning of the FAA with the goal of advancing safety.

3.2 Agency Independence

Agency independence in preexisting research is most prominently mentioned by Quintyn and Taylor (2002). They discuss it among 2 dimensions: Industrial independence and political independence. The role of agency independence in causing regulatory capture and the principal agent problem lies in the dimension of industrial independence (Stigler, 1971). The significance of the FAAs distance from Congress lies in the dimension of political independence, and the role of political interference in the functioning of the FAA as an independent agency. The autonomy the FAA has as an agency in relation to the Department of Transportation (DOT) and Congress has direct effect on its ability to function (Pelton, 2017).

This paper conceptualizes 'Agency Independence' according to the 4 dimensions of independence defined by Quintyn and Taylor (Quintyn & Taylor, 2002):

Regulatory independence refers to a regulators' autonomy in terms of rulemaking and setting regulations for those under the regulator's supervision. Specifically, the FAAs regulatory

independence from the House Committee on Transportation & Infrastructure. This includes the autonomy of the FAA from the House Committee to set regulation and discretions they have to change regulation within the confines of the law, as well as the means the FAA has to give feedback about laws and regulations to the House Committee. In the context of the research question the type of regulation analyzed is prudential regulation as defined by Quintyn and Taylor, since this involves the products and processes of the regulated firms and is most affected by the actions of the regulating agency, and the way external parties affect these actions. Economic regulation and information regulation as defined by Quintyn and Taylor are not as relevant to the case as they are not as adaptive and can thus be left to the lawmakers, the role of the regulating agency is small. Regulatory independence is important to ensure fast action when needed, stability, and expert input into regulation processes (Quintyn & Taylor, 2002).

Supervisory independence refers to a regulator's autonomy when licensing, supervising in the strict sense, sanctioning, and during crisis management, whether it is capable of performing these tasks by itself, without interference by the government or cooperation with the regulated parties. The state of supervisory independence of the FAA depends on the presence of governmental interference by either the House or industrial parties such as Boeing. Governmental interference is common so supervisory independence is one of the hardest forms of independence to achieve. In order to have supervisory independence, a regulatory agency also needs the necessary knowledge base and expertise to supervise the regulated parties. The main benefit of supervisory independence is the stability of the sector the regulator is regulating. (Quintyn & Taylor, 2002).

Institutional independence refers to the status of the regulator as an independent institution from the legislative power and ministry that govern over it. Is the regulatory agency an executive branch of the ministry that governs over it or does it have its own competences? The state of the FAAs institutional independence is determined by the FAAs independence from the DOT, the House committee, its place in the administration of the US government and how this affects the operations of the FAA. Institutional independence is important when responding to quickly changing markets, it determines how well regulators are able to act on their own. (Quintyn & Taylor, 2002).

Budgetary independence refers to the role of the executive or legislative power when deciding the budget of the agency, and how the agency will be able to use this budget. Budgetary independence is the FAAs autonomy over what its budget will be, where it is going, and the FAAs autonomy over its recruitment, staffing and salaries. Budgetary independence influences the regulator's ability to act quickly by distributing resources on a short-term basis, and it also influences the amount of political pressure on the agency from the executive or legislative power or financial pressure from the regulated parties (Quintyn & Taylor, 2002).

3.2 Regulatory Capture

"Regulatory capture takes place when a legal entity or an individual influences a government agency in the process of formation of public policy to obtain an advantage. In that sense, an interest group could "capture" the policymaking activity of an agency in an effort to impose a public agenda that favors its own welfare." (Oliveto, 2019) In this scenario, this usually happens

in the form of financial lobbying of policymakers, but other influencing tools include political pressure, cultural influence or cognitive influence (Oliveto, 2019). Depending on context, regulatory capture is more likely to happen. It can be selfishness of politicians (Stigler, 1971), producers and consumers (Peltzman, 1975). In the context of aviation regulation, regulatory capture can lead to situations where aviation industry interests are prioritized over aviation safety (Hoppe, 2019). Regulatory capture has affected the FAA through the revolving door (Chary, 2022), a situation where former agency employees, especially high-ranking officials, start working in the industry after their tenure at the regulator. Alternatively, the regulator can willingly let itself get captured. In this situation the regulator willingly acts according to the wishes of the industry rather than the public it is supposed to serve. This phenomenon is known as tacit collusion (Feltovich & Hamaguchi, 2018), where the regulator verbally agrees to serve the interests of the regulated.

There is suspicion that the FAA is a captured regulator, and that its ability to execute its regulatory responsibilities has been heavily compromised by regulatory capture, a situation where the regulated firms have so much influence over regulation that it mainly benefits them rather than the mission of the agency, which is supposed to serve the public. Prioritizing industry interests above safety interests can lead to dangerous situations (Oliveto, 2019).

The existence of a relationship between regulatory capture and agency independence can be explained through the previously mentioned concepts of tacit collusion (Feltovich & Hamaguchi, 2018) and the revolving door (Chary, 2022).

- The state of regulatory independence can lead to regulatory capture if the legislative power has a lack of oversight over regulations made by the agency compared to industrial parties. This influence imbalance leads to legislation that is more tailored to industrial parties rather than the interests of citizens represented through for example the parliament (Quintyn & Taylor, 2002). A regulatory agency that has a lot of regulatory freedom can more easily enter into non-verbal agreements with industrial parties, tacit collusion, without counter influence by the legislative power (Feltovich & Hamaguchi, 2018).
- The state of institutional independence can lead to regulatory capture in case of a lack of separation between the agency and ministry, or the agency and regulated parties (Aarts, 2022). A lack of separation between the agency and the ministry it falls under makes it hard for the agency to accomplish its own mission since the consequences of their actions fall on its parental ministry (Asselt et Al, 2018). This means that potential political pressure on the ministry translates to pressure on the agency (Pelton, 2017). It makes the agency more vulnerable to political interference, which in case of lobbying of politicians by regulated parties can translate into regulatory capture (Quintyn & Taylor, 2002). Lack of separation between the agency and regulated parties implies close contact and cooperation between the regulator and regulated parties which can translate into a regulatory agency that is serving the wishes of the regulated parties rather than the social mission it has to serve the public (Hoppe, 2019). This form of regulatory capture can occur when high ranking employees of either the regulator or regulated work for the other organization after their previous tenure at either the regulator or

regulated. An example of this is the revolving door, and it naturally leads to a lack of separation between the regulator and regulated (Chary, 2022).

3.3 Principal-Agent Problem

The principal-agent problem in terms of its involvement in agency independence is discussed in two forms of administrative interactions. The first is between government and the agency (McCubbins et al., 1989) and the second one is between the agency and the regulated (Laffont & Tirole, 1991). The principal-agent problem applies to situations where a principal requires an agent to perform a task for them. In theory this is beneficial to the principal assuming they have proper control over the transaction. However, in case either the principal or the agent gets too much control over the exchange, problems arise.

In a principal-agent relationship, there is power to be gained over the regulating agency by the regulated firms via information asymmetry (Laffont & Tirole, 1991). Firms can convince regulators that their market situation is worse than it actually is, convincing the agency to give them benefits in policy (Laffont & Tirole, 1991). This can create a principal-agent problem (McCubbins et al., 1989).

Asymmetric information has a negative effect on an agencies ability to regulate the firms under its supervision (Oliveto, 2019). This gap in information and expertise between regulator and firm is nigh impossible to overcome (Downer, 2010). Information asymmetry between the principal and the agent requires the principal to use more resources to properly regulate the principal-agent relationship. If the principal fails to provide these resources, the agent can abuse the relationship (McCubbins et al., 1989).

In the context of the FAA's relationship with Boeing this would imply a weak position for the principal, in this case the regulatory agency. The ineffectiveness of the FAA in its attempts to control its relationship with Boeing could lead to the development of unsafe practices at Boeing.

The relationship between principal-agent problems and agency independence is explained through the existence of information asymmetry between the regulator and the regulated (Downer, 2010).

- The state of supervisory independence can lead to a principal-agent problem if the regulator does not have the authority to hire the most competent supervisors with the most expertise, leading to a wide knowledge gap and a lot of information asymmetry between the regulator and the regulated. This can potentially lead to a principal-agent relationship between the regulator and regulated with very high transaction costs. In absence of a system with proper sanctions and interventions, it becomes even more difficult for the principal to control the relationship with the agent (Quintyn & Taylor, 2002).
- The state of budgetary independence can lead to a principal-agent problem if the regulator has a lack of funds that leads to a lack of expertise, which leads to a wide knowledge gap and a lot of information asymmetry. This leads to a principal-agent relationship with very high transaction-costs. If this lack of funds and necessary staffing

is compounded by political pressure to keep costs low, it becomes very hard to control this principal-agent relationship (Quintyn & Taylor, 2002).

4. Methodology

4.1 Research design

This thesis is a case study built on qualitative secondary data; it is descriptive in nature. Reasons for designing the thesis as a case study are the goal of providing new insight into the ongoing discourse on independent regulation and whistleblowing in the context of safety issues at Boeing that developed after the merger with McDonnell-Douglas in 1997. The single case study was chosen over a multiple case study due to the scope of the thesis, providing space to delve more deeply into the single case of the safety culture at Boeing and how public administration failure contributed to it. This is different from other studies on the topic of the safety problems at Boeing which put more attention on actions by Boeing rather than the regulators, which is the research gap this thesis is trying to fill. The main reason for using secondary data is the explanatory nature of the thesis: It involves Causal Process Tracing (CPT) of relationships between the independence of regulators and safety issues, specifically analyzing interaction between the FAA, the US congress and Boeing. These parties are difficult to get into contact with for collection of primary data, raising time constraints and inaccessibility issues. CPT is used to make a comprehensive story line of the development of a negative safety culture at Boeing, putting all the events that were deemed to be caused by the variables in the research question, the smoking guns, in chronological order as well as categorizing them according to the stakeholder that performed the action. Subsequently the motivations, perceptions and anticipations of the stakeholders are put into the perspective of this action. The result is a comprehensive story line, smoking guns, and confessions by actors that provide a more rigorous analysis of whether the events that led to the negative safety culture at Boeing had a relationship to regulatory capture and tacit collusion and subsequently the FAAs independence and the treatment of whistleblowers.

4.2 Research methods

This thesis researches a ‘X affects Y’ relationship: The causal relationship explaining how FAA independence influenced the safety culture at Boeing. The causal analysis involves literature review and content analysis. Information found in relation to the causal chain is summarized and categorized according to the conceptualization and dimensions.

This is backed up by the use of CPT. CPT involves ‘tracing’ the process from one causal factor to another to provide more internal validity to ‘X affects Y’ claims (Blatter & Haverland, 2012). Via analysis of ‘evidence’ it adds value to claims that divergent concepts affect each other in a causal chain. The additional value lies in additional logical scrutiny through the challenging of claims based only in theory, secondly it allows for empirical study of the causal claims based on theory, an opportunity to test whether the steps in the causal chain as described in theory are based in reality. If CPT disproves any of the described links in the causal chain, this provides theoretical benefits by showing where the theory of the causal mechanism needs to be revised (Reykers & Beach, 2017). The goal is identification of links leading from one variable to another, as well as identification of the circumstances in which X led to Y. The use of CPT in

constructing causal mechanisms is known to have analytical and theoretical and benefits due to the tools it provides to analyze delegation in principal-agent relationships, which is why it is a very valuable method for the case this thesis wants to investigate (Reykers & Beach, 2017; Beach and Pedersen, 2013). Additionally, CPT has previously been applied in research on the role of regulatory capture in safety issues (Heims & Moxon, 2024).

Validity of the research is further increased by the use of existing theories and explanations of the dimensions of concepts discussed in the literature used for this thesis, such as on regulatory capture and the principal-agent problem through data triangulation with a need for an extensive idea of all the dimensions that make up the concept to increase the content validity of the research. The use of the existing research is important in regard to the use of CPT in the study, which needs to be in conjunction with realistic evaluation principles. To make its use of CPT and causal mechanisms valid, the thesis abides by the following principles of realistic evaluation (Pawson & Tilly, 1997):

To make a valid claim that X causes Y one must:

- Provide the mechanism through which the causal relationship between X and Y is theoretically proven
- Provide the condition through which the existence of X leading to the occurrence of Y through the causal mechanism is empirically proven

4.3 Contextualized Expectations

Following the realistic evaluation principles, this thesis explains its theoretical expectations, contextualized for the case of the Boeing 737 MAX, by forming causal configurations for this specific case which are constructed through the combination of multiple causal mechanisms working in unison. These causal mechanisms form sufficient configurations, which are contextualized as sufficient conditions for … to occur (Blatter & Haverland, 2012). The theoretical expectations, relating to the relationship between the four dimensions of independence and the development of a negative safety culture at the Boeing Company, are as follows:

Condition A

1. The inadequate state of *regulatory independence* of the FAA from the US Congress, in which the Congress and the Ministry lacked influence over aviation safety rulemaking and regulations, contributed to the two Boeing 737-MAX crashes because of two conditions:

    a. The FAA colluded with Boeing on the topic of aviation safety regulation.

    b. Congressional support of the FAA could not balance collusion between the FAA and Boeing, due to an inability to influence rulemaking and rule setting on the topic of aviation safety

        - Causal mechanisms (1a) and (1b) promoted a poor safety culture at Boeing industries through regulatory capture caused by collusion

between the FAA and Boeing who shaped regulations to Boeing's wishes.

- **Causal configuration 1a + 1b = Condition A**

Condition B

2. The inadequate state of *institutional independence* of the FAA from the US government and Boeing, in which the appointment and dismissal of FAA officials was largely in control of the US government, contributed to the two 737-MAX crashes because of the following causal configuration:

    a. The US government appointed industry-favoring FAA officials.

    b. FAA and Boeing employees were appointed through a revolving door from the FAA to Boeing.

- Causal mechanisms (2a) and (2b) promoted a poor safety culture at Boeing industries through regulatory capture caused by industry favoring FAA officials travelling through the revolving door to Boeing, compromising FAA regulatory oversight by sharing agency practices with Boeing.

    - **Causal configuration 2a + 2b = Condition B**

Condition C

3. The inadequate state of *supervisory independence* of the FAA from Congress and the US government, in which the FAA lacked sufficient power to license, supervise, and sanction independently, contributed to the two Boeing 737-MAX accidents because of the following sufficient configuration:

    a. Delegation of supervisory responsibility to Boeing themselves due to lack of licensing power, supervisory power in the strict sense

    b. Information asymmetry between Boeing and the FAA

- Causal mechanisms (3a) and (3b) created a principal-agent problem which the FAA was unable to adequately govern due to a lack of sanctioning power. This promoted a poor safety culture at the Boeing Company.
    - **Causal configuration 3a + 3b = Condition C**

Condition D

4. The inadequate state of *budgetary independence* of the FAA from the US Congress and the US Government, in which the FAA had insufficient influence on the distribution of its budget and the size of this budget, contributed to the two Boeing 737-MAX crashes because of the following causal configuration:

a. The FAA delegated its supervision of Boeing (that required necessary expertise) to Boeing themselves due to a lack of necessary expertise to do it themselves

b. Information asymmetry between Boeing and the FAA

- Causal mechanisms (4a) and (4b) created a principal agent problem in which the FAA could not bridge the information asymmetry in regard to technical expertise. This promoted a poor safety culture at the Boeing Company.
  - **Causal configuration 4a + 4b = Condition D**

These 4 causal configurations each are sufficient conditions for the 737 MAX crashes to occur when arguing that they all promoted the development of a negative safety culture at the Boeing Company.

4.4 Operationalization

'Independence of the FAA as a regulator' is operationalized according to the presence of independence dimension indicators. The presence of an indicator is an indicator of the FAAs independence from either the House Committee on Transportation and Infrastructure or Boeing in each particular dimension of independence (Quintyn & Taylor, 2002).

- Indicators of regulatory independence
  - The FAA has discretion to set its own rules and regulations on products and processes (prudential regulation) under US law
  - The FAA has discretion to provide feedback and is transparent on laws and legislation to the legislative branch of government
- Indicators of supervisory independence
  - The FAA has established authority to supervise Boeing in the strict sense, without governmental interference by the executive and legislative branches of government or industrial interference by industrial parties
  - The FAA has established authority to sanction Boeing without governmental interference by executive or legislative branches of government
  - The FAA has established authority to grant or withdraw licenses (in this case, aircraft design certifications) without cooperation with the executive and legislative branches of government or industrial parties
- Indicators of institutional independence:
  - Terms of appointment and dismissal of personnel of the FAA are clearly established, based on the FAAs competence and not on their decisions
  - Governance structure: FAA commissions are composed of multiple members, who can be considered experts in their field, without overrepresentation of the Executive or the Legislative branches of government
  - The process of decision making is open and transparent, with opportunity for public and industrial scrutiny of the FAA without political interference by the Executive or the Legislative branches of government
- Indicators of budgetary independence

    - The FAA has independent authority over the allocation of its budget and its size
    - The FAA has independent authority over its personnel recruitment and the salary levels

The safety culture at Boeing is operationalized according to the FAAs report on the safety culture at Boeing (FAA, 2024), using the principles of the International Civil Aviation Organization (ICAO, 2018: 3-3). Safety culture issues are analyzed based on their source, severity, and the actions taken by the stakeholders based on scientific literature by Boin and Weick (Boin et al, 2013; Boin et al, 2016; Weick & Sutcliffe, 2015), and whether they trace back to the 'independence of the FAA as a regulator'. The elements of a negative safety culture at Boeing are analyzed in the following way:

- Source of the safety culture problem: What was the main cause of the safety culture issue?
- Severity of the safety culture problem: How much does this safety culture issue affect safety?
- Actions of stakeholders: What actions did stakeholders take in context of the safety culture issue?

4.5 Data collection and analysis

The data collection method is secondary data collection, because it is complicated to get into contact with the agencies, companies and institutions analyzed in this thesis. Any data used for the thesis is literature on the actions of the FAA, the US government, and Boeing in the period between 1996 and 2019. The sources of this data are:

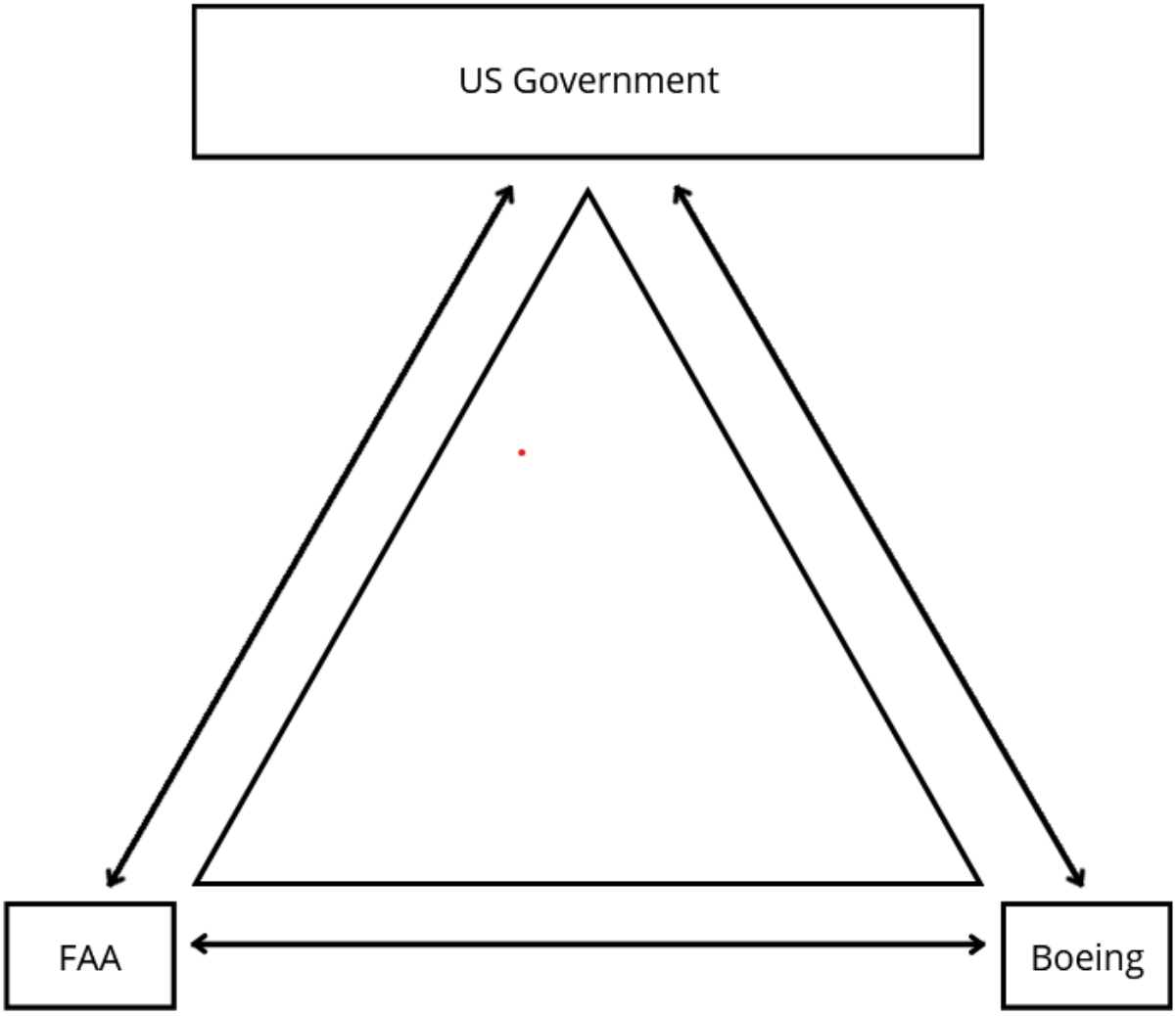
- Journalistic literature commenting on events concerning the FAA, the US government, and Boeing between 1996 and 2019
- Scientific literature commenting on events concerning the FAA, the US government, and Boeing between 1996 and 2019
- Independent investigative reports commenting on events concerning the FAA, the US government, and Boeing between 1996 and 2019
- Documentaries commenting on events concerning the FAA, the US government, and Boeing between 1996 and 2019
- Transcriptions of interaction between the FAA, the US government, and Boeing between 1996 and 2019

The data analysis has a sequential approach. The literature review and content analysis of secondary data concerning the FAA, the US government, and Boeing, coded with Atlas.ti, is used for CPT to describe and illustrate the relationships mentioned in the sub questions.

5. Analysis & Results

5.1 Timeline and actors

The timeline of events relevant to the crashes of LNI 610 and ETH 302 involves 3 significant actors that are part of this analysis: The FAA, Boeing, and the US Government including the US Congress and the Ministry of Transport and Infrastructure. Most of the events described in the timeline concern the actions of one of these three affecting another one of the actors in this triangle, or an observation by external actors about the actions by one these three actors. The triangular relationship itself will be further explained in the theoretical framework.



The FAA is the aviation regulatory agency in the United States. They are responsible for regulating civil air travel to ensure it is safe, as well as encouraging civil aviation development in the country through technological innovation. Other tasks they are responsible for include the management of the Air Traffic Control system, engaging in their R&D activities on the topic of civil aviation, striving for environmental goals to combat the environmental effects of civil aviation, and lastly regulating commercial space transportation. The main focus of this thesis is on the FAAs management of its task of safety regulation, which includes aircraft certification, as well as the organization of the FAA (FAA. 2024). The

FAAs position in the interaction between the actors is as the regulatory supervisor of Boeing, under legislative authority of the US Congress.

The Boeing company is the largest manufacturer of commercial aircraft in the United States, and the designer of the Boeing 737 MAX. In their interaction with the FAA, they mainly interact on the grounds of aircraft design and safety inspection (Boeing. 2024).

The US congress is the legislative power in the United States and interacts with the FAA in regard to what legislation the FAA will execute and how the FAA is allowed to execute this. The area of congress that specifically concerns itself with aviation legislation is the House Committee on Transport and Infrastructure, through its Aviation subcommittee (US House Committee on Transportation and Infrastructure). This is done through the Ministry of Transportation and Infrastructure, which the FAA is a part of.

Timeline as described in 'Flying Blind' (Robison, 2021) & the Final report from the House Committee inquiry (US House Committee on Transportation and Infrastructure, 2020).

1996:	*FAA personnel reform* As mandated by congress, a new transportation funding bill goes into effect which reforms personnel financial compensation by putting more focus on factors like efficiency, customer service, and modernization. Overall budget at the agency was not increased.
December 1996:	*Boeing McDonnell Douglas merger* Boeing and McDonnell Douglas announce their intention to merge, henceforth continuing under the Boeing name. Phil Condit becomes the Chief Executive Officer (CEO), Harry Stonecipher the President and Chief Operating Officer (COO).
October 1998:	*Recommendation for transfer of regulatory authority* Thomas McSweeny, director of the FAA certification office, receives a recommendation from Webster Heath for the "earliest possible issuance" of new legislation transferring regulatory authority to manufacturers themselves.
September 2002:	*Marion Blakey appointed FAA administrator* Marion Blakey is sworn in by President Bush as the 15th administrator of the FAA.
February 2003:	*Announcement customer service initiative* Marion Blakey announces the 'customer service initiative', shifting the FAAs priorities away from the flying public and putting more emphasis on manufacturers and airlines.
December 2003:	*Phil Condit resigns* Condit resigns as CEO of Boeing, Stonecipher comes out of retirement to succeed him. President Bush signs congress' the new aviation funding bill in which congress mandates for changes in agency supervision as "a means to provide more effective certification services to its customers" (Robison. 2021)

March 2004: *787 product launch*
Boeing launches their new aircraft design, the 787 Dreamliner. The company deadline for completion of this project is September 30th, 2007.

March 2005: *Stonecipher replaced by McNerney*
Stonecipher is fired by the board. Jim McNerney succeeds him, as opposed to Boeing veteran Alan Mulally.

November 2005: *ODA legislation*
Congress mandates a new organizational chart in which the FAA supervises safety at Boeing through use of an Organization Designation Authorization (ODA). This was done through the Boeing Safety Oversight Office. This new organizational chart put Boeing in charge of the selection of the members of this panel, rather than the FAA. Additionally, the members of the Boeing Safety Oversight Office answered to a manager at Boeing rather than a manager at the FAA.

September 2007: *787 misses production deadline*
The deadline for 787 production is missed due to developmental delays.

November 2009: *Completion ODA transition*
The ODA transition as mandated in 2005 is completed. The FAA authorizes Boeing to have multiple ODAs. Boeing is now supervised by the Boeing Aviation Safety Oversight Office (BASOO).

December 2010: *Launch of the A320neo*
Airbus launches the Airbus A320neo program, a reengined variant of its A320.

June 2011: *American Airlines A320neo order*
American Airlines, one of Boeing's most important customers, places a significant order for the A320neo at the Paris Airshow.

July 2011: *Announcement new 737*
Boeing announces it will create a new variant of the 737 in a deal with American Airlines. The airline agrees to split their original order 50/50 between Boeing's new 737 and the A320neo.

August 2011: *Launch 737 MAX*
Boeing launches the 737 MAX program, a reengined variant of the 737.

April 2012: *Expansion ODA programs*
The FAA establishes a rulemaking committee in response to the FAA Modernization and Reform Act that called for more cooperation on the grounds of the effectiveness of the FAAs certification processes in regard to the interpretation of rules and regulations. As a response to the rulemaking committee's recommendations the FAA expands its ODA programs through the Aircraft Certification Service (AIR).

June 2012: *Complaints against Ali Bahrami*
The FAA Transportation Department Inspector General's office is questioned regarding complaints about Ali Bahrami, the manager of the Transport Airplane Directive, excessively relaxing oversight of Boeing.

January 2013: *787 battery fires and grounding*
A battery fire breaks out onboard a 787 Dreamliner while parked at Boston Logan Airport. Later the same month, smoke onboard an All-Nippon

	Airways 787 Dreamliner forces it to divert. The FAA grounds the 787 Dreamliner.
April 2013:	*787 recertification* The FAA ends the grounding of the 787 Dreamliner.
2013:	*Continued delegation to Boeing* The BASOO delegates 28 out of 89 certification duties for the 737 MAX to Boeing themselves.
June 2013:	*MCAS designation discussion* Boeing engineers discuss the transparency about the MCAS system, and decide to internally label it as such, but externally refer to it as a "tweak of the existing flight controls, reducing the chance that anyone might ask questions about it" (Robison. 2021).
November 2014:	*NTSB 787 report* In its final report on the 787 battery fires, the National Transportation Safety Board (NTSB) concludes that there are "numerous problems with Boeing's design and testing and with FAA's oversight of Boeing".
June 2015:	*Announcement Compliance Program* The FAA announces the Compliance Program, a safety enforcement policy that puts more focus on collaboration and training rather than punishment through civil penalties. Boeing pledges to implement its plan for a Safety Management System as mandated by the 2005 legislation.
July 2015:	*Muilenburg succeeds McNerney* Dennis Muilenburg succeeds Jim McNerney as the CEO of Boeing.
January 2016:	*737 MAX first flight* The 737 MAX makes its first flight.
November 2016:	*Further delegation to Boeing and MCAS secrecy* By this time the BASOO has delegated 79 out of 91 certification tasks for the 737 MAX to Boeing themselves. Boeing engineers hand over the MCAS safety system assessment to the FAA, not including changes made to the software in August, that drastically impacted the effectiveness of the system on flight.
February 2017:	*Report on the BASOO* The National Air Traffic Controllers Association (NATCA), Professional Aviation Safety Specialists (PASS), and the American Federation of State, County and Municipal Employees (AFSCME) publish a report that warns about the shortcomings of the BASOO and the lack of engineering involvement in safety oversight.
March 2017:	*737 MAX certification* The FAA certifies the 737 MAX.
July 2017:	*Ali Bahrami appointed FAA administrator* Ali Bahrami becomes the new associate administrator for the FAA. The new ODA reorganization through the AIR is completed.
October 2018:	*Crash of Lion air flight 610* LNI 610 crashes shortly after takeoff from Jakarta, killing 189 people.

March 2019: *Crash of Ethiopian Airlines flight 302*
ETH302 crashes shortly after takeoff from Addis Ababa, killing 157 people.

October 2019: *JATR report*
According to a JATR (Joint Authorities Technical Review) report, the BASOO is heavily understaffed with as little as 40 underqualified FAA employees supervising as many as 1500 Boeing ODA unit members.

5.2 Description of the State of FAA Independence

5.2.1 State of Regulatory Independence

- There is evidence that the FAA has discretion to set its own prudential regulation
- There is no mention of the contrary in the analyzed literature
- There is no mention of discretion regarding transparency in the analyzed literature
- The theory argues this state of regulatory independence leads to a risk of regulatory capture

Discretion: The analysis of the regulatory independence of the FAA showed evidence of discretion to set regulation and rules regarding products and processes, prudential regulation. The FAA's discretion to set these regulations is rooted in the agency's duty to govern the US airspace and ensure aviation safety (Pelton, 2017: 3, 4). In isolation this is not problematic, the discretion as mentioned by Pelton would not imply anything problematic according to the theory, it implies the existence of necessary regulatory independence to ensure fast action and stability during the rulemaking process by the agency. The FAA administrative authority over rulemaking and regulation is also specifically emphasized by chapter 1, section 106 2A of the US constitution, as well as 3A of the same document (2021: 28). This same discretion to set prudential regulation is emphasized Pelton cites the US constitution to make the same point (Pelton, 2017: 4). Additionally, Pelton argues that the FAA's rulemaking discretion is necessary to the separation of powers (Pelton, 2017: 8). The analyzed policy documents on this issue showed no evidence of a lack of discretion to set prudential regulation, and the literature did not show evidence of the other indicator of regulatory independence: "The FAA has discretion to provide feedback and is transparent on laws and legislation to the legislative branch of government." (US Constitution ch1 sec106, 2021: 28). Studies on the FAA's discretion to set prudential regulations shows the agency uses its freedom to set regulations within the confines of legislation set by congress.

Transparency: The FAA is not transparent towards the legislative power about its use of discretion. According to the theory this could be problematic as a lack of congressional oversight can lead to lack of congressional influence on regulations in favor of industry parties, leading to risk of regulatory capture. Due to an absence of evidence, neither suggesting regulatory transparency or denying regulatory transparency, it is difficult to make the argument that the state of regulatory independence of the FAA is inadequate. The lack of influence of the NTSB on FAA regulations would suggest an amount of regulatory discretion that makes the state of FAA regulatory independence inadequate due to Robison's implications that the FAA is more prone to industry capture due to lack of focus on safety in favor of industry growth (Robison, 2021: 119).

NTSB influence: What can be deemed problematic is the FAA's regulatory independence from other agencies. It is especially problematic that FAA is independent from the NTSB, which has no influence on any safety related regulation (Robison, 2021:119). The NTSB lacks the power to impose findings and recommendations on FAA safety regulations (Robison: 2021: 119).

5.2.2 State of Institutional Independence

- There is evidence that the terms of appointment of FAA personnel and officials is often based on FAA decisions due to the political influence the executive has on these appointments. Subsequently all other appointments in the agency are affected by this, even if there is evidence that these appointments are made without direct political influence by the executive
- There is evidence of overrepresentation of political appointees in FAA commissions
- Evidence about transparency of FAA decisions is inconclusive
- The theory argues this state of institutional independence can lead to regulatory capture through governmental interference

Political appointees: The literature showed evidence of political involvement in the appointment of FAA officials and personnel. The FAA Administrator is appointed by the president (with consent of the senate), and the Federal Aviation Management Advisory Council consists of a transportation secretary designee, a defense secretary designee, and 13 presidentially appointed members, approved by the senate, who uphold the interests of aviation in the US (Pelton, 2017: 2). The Council advises the FAA Administrator on FAA policy (US constitution ch1 sec106, 2021: 31). While the agency, through the authority of the administrator, has the power to independently hire its own personnel (US Constitution ch1 sec106, 2021: 28), the political nature of the appointment of the officials that are responsible for this recruitment makes the hiring of FAA employees politically motivated by extension.

Terms of appointment: In the literature evidence can be found for the judging of FAA employees based on their decision-making, due to the influence of the presidential administration on the officials and by extent the employees, such as through bonuses for the achievement of 'performance goals' that aimed to achieve the presidential administrations view of how the agency should operate (Robison, 2021: 121). According to Robison (2021: 121) this practically results in employees being rewarded for their support of industrial parties. Robison even suggests the careers of FAA employees could depend on their compliance with FAA policy (Robison, 2021: 128). Robison also described an instance of retaliation against FAA employees that would not comply with management and industry favoring policy (Robison, 2021: 129). This perception was shared among FAA employees in a MITRE survey, they consistently felt pressured to act in favor of the industry by order of their FAA superiors, and felt reluctant to report safety concerns to authorities higher up in the organization (MITRE, 2020: 32). The common theme is fear of retribution among employees (MITRE, 2020: 41). The MITRE survey also suggests that accountability regarding safety in the organization is poorly defined (MITRE, 2020: 43).

Transparency: Evidence for transparency of decision-making was rare in the analyzed literature and inconclusive, not clearly indicating a presence of or a lack of transparency of FAA decision-making.

5.2.3 State of Supervisory Independence

- There is evidence that the FAA lacks established authority to supervise Boeing in the strict sense, sanction Boeing, or certify Boeing aircraft without interference by the legislative, the executive, or industrial parties like Boeing themselves
- There is a lack of evidence to the contrary in the analyzed literature
- The theory argues that this state of supervisory independence could lead to principal agent problems

Certification: The analysis of the literature showed that the FAA had to cooperate extensively with Boeing during the certification process of the 737 MAX under the Organization Designation Authorization (ODA), and that this was viewed as a safety issue by FAA employees (MITRE, 2020). Under the ODA program the FAA relies on Boeing Authorized Representatives (AR) to carry out the supervision of Boeing aircraft design, who according to the report by the House Committee on Transportation and Infrastructure were heavily influenced by Boeing. The ODA legislation mandating delegation of supervision to Boeing in combination with the industrial influence through Boeings own appointment of these ARs suggests the FAA did not have established authority to certify Boeing aircraft without cooperation with the legislative branch of government and industrial parties. Additionally, a member of the Boeing Aviation Safety Oversight Office (BASOO) indicated a lack of power to influence design decisions showing the lack of power the FAA had over this process as a supervisor (Robison, 2021: 138). In fact the lack of authority the FAA had over certification was further diminished when in 2018 a funding bill stripped the FAAs authority to decide whether a company like Boeing was qualified to certify its own aircraft designs (Robison, 2021: 171).

Supervision in the strict sense: The 2018 funding bill not only affected certification and license granting but supervision in the strict sense as well (Robison, 2021: 171). The ODA system through Boeing ARs was prone to industrial interference by Boeing (US House Committee on Transportation and Infrastructure, 2020: 114). FAA employees' supervisory activities are consistently interfered with by government appointed higher ups in the organization and FAA staff feels intimidated and overpowered by industry members during meetings regarding certification and supervision (MITRE, 2020: 32). It suggests that the FAA does not have established authority to supervise Boeing in the strict sense without governmental and industrial interference. The fact that Boeing could choose its own ARs also enforces this same point (Robison, 2021: 127). There is even evidence that Boeing could threaten supervisors to influence the supervision by the FAA (Robison, 2021: 156).

Sanctioning: The House committee report argued that punishment of Boeing safety violations by the FAA was minor and that enforcement by Boeing ARs was practically nonexistent due to their allegiance to Boeing. Additionally, the FAA lacked a central authority for its compliance program making it ineffective in ensuring Boeing's compliance with safety standards (US House Committee on Transportation and Infrastructure, 2020: 84).

5.2.4 State of Budgetary Independence

- There is evidence that the FAA has independent authority over its personnel recruitment, and the salary levels, but there is also evidence to the contrary in the analyzed literature
- There is evidence that the FAA has a lack of independent authority over its budget and its allocation, in the analyzed literature
- The theory argues that this state of budgetary independence could lead to principal agent problems

Workforce recruitment: The literature showed that the US constitution has numerous assurances of the FAA's independence regarding its workforce recruitment (Pelton, 2017: 4), and underlines the authority and power the administrator has over the personnel recruitment and membership of the Advisory Council. The provisions under the constitution mainly focused on budgetary independence from the executive power through distance from the DOT (Pelton, 2017: 6). This authority over its personnel recruitment is again underlined by Pelton (2017: 7). Under the US Constitution the FAA administrator is authorized to appoint and dismiss employees and experts wherever they deem needed, this includes the possibility to request help from other agencies' workforce (US Constitution ch1 sec106, 2021: 30). However, as mentioned in the previous section, the FAA cannot appoint the ARs supervising Boeing, as they are Boeing appointed. This means the FAA has no authority over the people that carry out this important task for them (US House Committee on Transportation and Infrastructure, 2020). As mentioned before, the Administrator is politically appointed by the president making hires under their responsibility indirectly politically motivated.

Budget allocation: The FAA experiences shortages both in number of staff and in expertise (MITRE, 2020: 7, 33). According to Robison these staff shortages were caused by budget cuts leading to a fall of the workforce (Robison, 2021: 121). It is stated in the US constitution that the FAA cannot implement policy that will lead to exceeding its budget unless discussed with congress (US constitution ch1 sec106, 2021: 28). This implies a lack of independent authority of the FAA over its budget as well as its allocation, extending to a lack of independent authority over its personnel recruitment and salary levels due to a lack of funds to afford new staff. The FAA is reliant on Congress for the size of its budget (Pelton, 2017: 10). The earlier mentioned 2018 funding bill cut into the funding of the FAA further emphasizing the non-presence of authority of the FAA over its budget size and the allocation of the budget (Robison, 2021: 171). In the US constitution the budget allocation and size are strictly laid out from 2018 until 2023, again suggesting a non-presence of FAA authority over the budget and its size (US constitution ch1 sec106, 2021: 29).

5.3 Regulatory capture and the principal-agent problem

5.3.1 Collusion and a lack of congressional power

Following the CPT principles laid out in the methodology, this analysis main focus is on the presentation of literature that provides evidence for the occurrence of the causal mechanisms 1a and 1b, that the occurrence of causal mechanisms 1a and 1b traces back to the FAA's state of regulatory independence, and that these causal mechanisms together produce sufficient condition A:

1. The inadequate state of *regulatory independence* of the FAA from the US Congress, in which the Congress and the Ministry lacked influence over aviation safety rulemaking and regulations, contributed to the two Boeing 737-MAX crashes because of two conditions:
    a. The FAA colluded with Boeing on the topic of aviation safety regulation.
    b. Congressional support of the FAA could not balance collusion between the FAA and Boeing, due to an inability to influence rulemaking and rule setting on the topic of aviation safety
        - Causal mechanisms (1a) and (1b) promoted a poor safety culture at Boeing industries through regulatory capture caused by collusion between the FAA and Boeing who shaped regulations to Boeing's wishes.
            - **Causal configuration 1a + 1b = Condition A**

Collusion: Collusion, willingly serving the interests of the regulated industrial party rather than the interests of the public, is a form of industrial interference. Evidence for collusion between the FAA and Boeing is found in the 737 MAX final report made by the House Committee on Transport & Infrastructure (US House Committee on Transportation and Infrastructure, 2020). The report speaks of FAA employees being overruled by management on the topic of Boeing's compliance with FAA regulations, arguing that FAA management is overly concerned with the interests of industrial stakeholders rather than the safety of Boeing's aircraft design (US House Committee on Transportation and Infrastructure 2020: 14).[2] Boeing received an exception on an aircraft system, the Engine Indicating and Crew Alerting System (EICAS), that was mandatory according to FAA regulation (US House Committee on Transportation and Infrastructure 2020: 17).[3]

Prioritizing Boeing interests: The FAA's concern with Boeing interests is again highlighted by the approval of computer based training for the MAX that argued much less time was needed to complete the training than even Boeing anticipated (US House Committee on Transportation and Infrastructure, 2020: 26). Boeing's influence on FAA regulation affected FAA decision

[2] More evidence of the FAA siding with Boeing is found on page 16, page 57, page 77 and page 80 of the report, stating overruling by FAA management of FAA technical experts in favor of Boeing aircraft designs that were deemed to be in violation of FAA regulations (US House Committee on Transportation and Infrastructure, 2020).
[3] This is further described on page 47 of the report (US House Committee on Transportation and Infrastructure, 2020).

making after the Lion air crash, with the omission of MCAS references in the advisory and the airworthiness directive issued in November 2018 (US House Committee on Transportation and Infrastructure, 2020: 28, 198). The design of MCAS using only one AOA sensor was deemed compliant with FAA regulation, and after the first crash, despite a risk analysis showing a high risk of another crash, the MAX was allowed to keep flying with the argument that there was not enough data to support the analysis (US House Committee on Transportation and Infrastructure, 2020: 29, 211).[4] The 737 MAX received an 'Amended Type Certification' which removed the need for modern safety features on the aircraft ((US House Committee on Transportation and Infrastructure, 2020: 49).

Industrial pressure: A 2020 safety culture survey revealed employee concerns around the FAA's safety mission and the industry pressure that affects decisions made by the agency (US House Committee on Transportation and Infrastructure, 2020: 57). The willingness of the FAA to appease Boeing affects decision-making (US House Committee on Transportation and Infrastructure, 2020: 81). The FAA followed Boeing's reasoning that the pilots were to blame for the Lion air crash and not the MCAS system (US House Committee on Transportation and Infrastructure, 2020: 204). Despite evidence of the inadequacy of the MCAS design process, the FAA deemed there was no breach of regulations by Boeing (US House Committee on Transportation and Infrastructure, 2020: 208, 209). The FAA suffered from industrial pressure (US House Committee on Transportation and Infrastructure, 2020: 234). The FAA's senior leadership can be seen as overly concerned with the interests of industry stakeholders (MITRE, 2020: 6, 34).

Congressional influence: Congressional influence does not just concern the legislative power the congress has, but also its ability to oversee the executive, which the FAA is a part of through the DOT. Evidence for congressional influence on FAA regulation, can be found in the US Constitution and Pelton's work (2017: 3). The duty of the FAA is to carry out approved legislation by congress and in this sense, congress has influence over the FAA's decisions (Pelton, 2017: 8). However, the US constitution states that the FAA Administrator is the final authority regarding regulations and rules (US constitution ch1 sec106, 2021: 28). In other words, congress has no influence on how its legislation is executed by the FAA, except through the budget of the agency (US constitution ch1 sec106, 2021: 29). It is not possible for Congress to increase oversight and influence over FAA regulation without a constitutional amendment, which is difficult to make. This is evidence for a lack of congressional influence, since the congressional influence is undone by the power of the FAA administrator.

5.3.2 Hiring of officials and the revolving door

Following the CPT principles laid out in the methodology, this analysis main focus is on the presentation of literature that provides evidence for the occurrence of the causal mechanisms 2a and 2b, that the occurrence of causal mechanisms 2a and 2b traces back to the FAA's state of institutional independence, and that these conditions together produce sufficient condition B:

[4] This was further reinforced when the FAA agreed with Boeing's judgement that the AOA disagree alert did not present a safety issue (US House Committee on Transportation and Infrastructure, 2020: 134).

2. The inadequate state of *institutional independence* of the FAA from the US government and Boeing, in which the appointment and dismissal of FAA officials was largely in control of the US government, contributed to the two 737-MAX crashes because of the following causal configuration:

    a. The US government appointed industry-favoring FAA officials.

    b. FAA and Boeing employees were appointed through a revolving door from the FAA to Boeing.

        - Causal mechanisms (2a) and (2b) promoted a poor safety culture at Boeing industries through regulatory capture caused by industry favoring FAA officials travelling through the revolving door to Boeing, compromising FAA regulatory oversight by sharing agency practices with Boeing.

            - **Causal configuration 2a + 2b = Condition B**

Industry favoring FAA officials: The appointment of industry favoring officials is a form of governmental interference. Evidence for the appointment of industry favoring officials by the US government, includes the perceived preoccupation of Aviation Safety Organization (AVS) officials with industry interests, which could negatively affect the safety culture of the FAA (US House Committee on Transportation and Infrastructure, 2020: 234). The involvement of the US government with the presence of industry favoring officials at the FAA includes the appointment of Marion Blakey as FAA administrator by George W. Bush, who stated the need for the agency to take a more service oriented approach towards what she called the 'customers' of the agency (Robison, 2021: 123). And Ali Bahrami, the FAA administrator appointed by Donald Trump in 2017, stated at a conference that he was "excited about working with the industry, rather than against it, to address safety issues." (Robison, 2021: 170). Ever since 1996 the US government, through congress, stimulated industry favoring officials and employees at the FAA through rewards based on aircraft manufacturer support (Robison, 2021: 121). FAA senior management is easily pressured by the industry when FAA employees are perceived to be blocking the wishes of these industrial parties (MITRE, 2020: 6). The preoccupation of high FAA management with industry interests is felt through fear of retribution for reporting safety issues with Boeing design (MITRE, 2020: 41). There is a perception that the performance of FAA employees is graded based on their ability to meet industry performance targets rather than organizational performance targets (MITRE, 2020: 32).

Revolving door: The revolving door is a figurative door between the agency and regulated parties, which if crossed can lead to capture of the agency, either through occupation of management positions by industry favoring officials, or through the sharing of agency practices by those who work for regulated parties after their tenure at the agency. Evidence for the revolving door between the FAA and Boeing, includes the career path of Ali Bahrami: He was working at McDonnell-Douglas before joining the FAA the first time in 1989, staying until 2013 (US House Committee on Transportation and Infrastructure, 2020: 214). After that first period he joined the Aerospace Industries Association (AIA), an aviation trade group that represents the interests of Boeing and other aviation industry stakeholders, before being

appointed the FAA administrator in 2017 (US House Committee on Transportation and Infrastructure, 2020: 214).[5] According to former colleagues the FAA's shift to a more business oriented operation helped him climb the ranks of the agency as a former industry member (Robison, 2021: 127). Former FAA Administrator Marion Blakey joined the AIA in 2007 after her tenure as FAA administrator, and long time FAA official Thomas McSweeney made the direct switch to Boeing themselves in the same year (Robison, 2021: 126). Robison speaks of Boeing veterans reaching high positions in FAA management (Robison, 2021: 16). Potential negative effects of FAA officials with history in the aviation industry described in the MITRE survey (2020: 34) include too much trust in the aviation industry that the FAA is supposed to supervise (MITRE, 2020: 34).

5.3.3 Over-delegation and information asymmetry

Following the CPT principles laid out in the methodology, this analysis main focus is on the presentation of literature that provides evidence for the occurrence of the causal mechanisms 3a and 4a, and how both these causal mechanisms, despite their different origins, combine with the identical causal mechanisms 3b and 4b to form sufficient conditions C and D:

3. The inadequate state of *supervisory independence* of the FAA from Congress and the US government, in which the FAA lacked sufficient power to license, supervise, and sanction independently, contributed to the two Boeing 737-MAX accidents because of the following sufficient configuration:

    a. Delegation of supervisory responsibility to Boeing themselves due to lack of licensing power, supervisory power in the strict sense

    b. Information asymmetry between Boeing and the FAA

        - Causal mechanisms (3a) and (3b) created a principal-agent problem which the FAA was unable to adequately govern due to a lack of sanctioning power. This promoted a poor safety culture at the Boeing Company.
            - **Causal configuration 3a + 3b = Condition C**

4. The inadequate state of *budgetary independence* of the FAA from the US Congress and the US Government, in which the FAA had insufficient influence on the distribution of its budget and the size of this budget, contributed to the two Boeing 737-MAX crashes because of the following causal configuration:

    a. The FAA delegated its supervision of Boeing (that required necessary expertise) to Boeing themselves due to a lack of necessary expertise to do it themselves

    b. Information asymmetry between Boeing and the FAA

[5] Bahrami's career path is also mentioned in his interview with the House Committee in 2019 (US House Committee on Transportation and Infrastructure, 2019: 9, 10).

- Causal mechanisms (4a) and (4b) created a principal agent problem in which the FAA could not bridge the information asymmetry in regards to technical expertise. This promoted a poor safety culture at the Boeing Company.
    - **Causal configuration 4a + 4b = Condition D**

Excessive delegation due to lack of supervisory authority: A lack of supervisory authority, for example through an agency's lack of authority to select its own supervisors, can force an agency to excessively delegate supervisory responsibilities to the regulated parties. Evidence for excessive delegation due to loss of supervisory authority, includes general concern regarding the amount of safety certifications the FAA delegates to the industry, and that the ODA program's structure has negative effects on the oversight capabilities of the FAA (US House Committee on Transportation and Infrastructure, 2020: 15, 55). The house report mentions issues with implementation and operation of the ODA program, which includes the reducing of engineering involvement with certification of Boeing aircraft (US House Committee on Transportation and Infrastructure, 2020: 61, 64). Delegations made under the ODA program were deemed to have caused safety issues (US House Committee on Transportation and Infrastructure, 2020: 77). Decisions delegated to ODA's under the ODA program compromised certification processes (US House Committee on Transportation and Infrastructure, 2020: 94). These delegations included the oversight of crucial aircraft systems related to MCAS (US House Committee on Transportation and Infrastructure, 2020: 101).

Oversight delegation: The Boeing ARs, who under the ODA program where delegated lots of responsibility over certification and oversight of aircraft design, indicated they experienced undue influence from Boeing according to an internal survey with 520 Boeing ARs (US House Committee on Transportation and Infrastructure, 2020: 185, 186). And an FAA survey revealed 54% of respondents believed the FAA did not delegate oversight appropriately to external designees such as Boeing (US House Committee on Transportation and Infrastructure p.234, 2020). According to the MITRE survey the FAA (under the title of the US constitution) has delegated too much authority to industry and they argue the ODA model has moved the FAA away from a safety focused approach to oversight (MITRE, 2020: 7). There is confusion about the FAA's role, whether it is merely a regulator or also a promoter of safety, as well as a fear that the safety of the flying public now depends on the safety culture of the industrial parties the FAA 'serves', and how this negatively affects the effectiveness of oversight (MITRE, 2020: 33).

Inexperienced supervisors: Robison (Robison, 2021: 117) shares his sentiment about the BASOO and its place in the ODA program, stating "The first organizational charts sent around about this new system— mandated by Congress—had the headshot of the FAA manager in charge underneath his counterparts at Boeing. The implication was clear enough: the regulators were there in service of Boeing, not to police them." Under the ODA system introduced in 2009, Boeing was put in charge of choosing its own 'supervisors' who answered to a Boeing manager, another example of delegation due to legislation (Robison, 2021: 118). Under the ODA system, Boeing used the delegation of power to hire inexperienced engineers, who are more prone to managerial influence, into the roles of safety inspector on the BASOO (Robison, 2021: 127,

128). A young BASOO recruit gives a great example of the lack of power a Boeing inspector has, which extends to the agency they are supposed to serve (Robison, 2021: 138).

Excessive delegation due to lack of necessary expertise: A lack of necessary expertise to carry out certification can force an agency into excessive delegation of certification tasks to the regulated parties, because they are unable to do it themselves. Evidence for excessive delegation due to lack necessary expertise, includes the argument that the delegation under the ODA program is there to spare the FAA's limited number of resources (US House Committee on Transportation and Infrastructure, 2020: 58, 68). The implementation of the ODA program was flawed according to the House Committee, arguing that training issues led to engineers that were not qualified to carry out their responsibilities under the ODA program (US House Committee on Transportation and Infrastructure, 2020: 61, 62).

Training problems: The House report argues that training of Boeing ARs would dramatically increase the effectiveness of the ODA program, arguing that training the ODA representatives would increase the oversight the FAA has over them (US House Committee on Transportation and Infrastructure, 2020: 73). According to the House report, the FAA needs to improve its understanding of human factors and their relationship to automation during certification (US House Committee on Transportation and Infrastructure, 2020: 233). Boeing ARs themselves wondered if the FAA who they technically answer to, understood the designs they were accepting: "There is no confidence that the FAA is understanding what they are accepting (or rejecting)" (US House Committee on Transportation and Infrastructure, 2020: 75). Back in 2013 when the Boeing 787 was grounded, the NTSB argued that "insufficient guidance for FAA "certification engineers to use during the type certification process to ensure compliance with applicable" FAA requirements" was a major problem that needed to be addressed to prevent another incident, and the House report argues this same problem was also a factor in the 737 MAX accidents (US House Committee on Transportation and Infrastructure, 2020: 77). The House report argues the FAA lacked understanding of the MCAS system that led to the accident, partly also due to extensive delegation to Boeing of up to 90% of certification related tasks (US House Committee on Transportation and Infrastructure, 2020: 101). Certification tasks that were originally meant to be assessed in house, such as the MCAS related stabilizer system, were delegated to Boeing anyway after reconsidering (US House Committee on Transportation and Infrastructure, 2020: 101). The MITRE survey argues there is room for substantial improvement of safety related training, with the main criticisms being that the training is outdated, infrequent, and not appropriately planned (MITRE, 2020: 40). To quote the MITRE survey (MITRE, 2020: 12): "There are not enough resources, manpower, and training dedicated to safety."

Staffing problems: The FAA's oversight of MCAS was flawed (US House Committee on Transportation and Infrastructure, 2020: 120). The FAA suffered from staffing problems, with the House report describing teams of engineers that lack experience and general manpower, who oversee 1500 Boeing ARs and are thinly stretched (US House Committee on Transportation and Infrastructure, 2020: 65). AVS surveys revealed 52% of participants felt there was a lack of manpower focused on safety (US House Committee on Transportation and Infrastructure, 2020: 69). The MITRE survey conclude that human capital challenges led to

deterioration of the FAA's safety culture, with overburdened staff, training and skill gaps, and turnover of key staff (MITRE, 2020: 7). This lack of staff is further expanded upon in the MITRE survey, reporting dissatisfaction with new roles, administrative burdens, and worries about lacking the manpower to execute proper oversight (MITRE, 2020: 33). The MITRE survey describes an agency that lacks staff due to unattractive salaries, applies staff incorrectly or overextends staff, which impacts safety (MITRE, 2020: 38). The new engineers that are hired are often very inexperienced (MITRE, 2020: 39). Robison mentions that the agencies budget was held flat from 1996 to 2012, and in that time the agencies workforce fell by 4% (Robison, 2021: 121). Robison illustrates the inexperience of FAA hires and general lack of technical expertise of FAA officials, like they are "dogs watching TV" (Robison, 2021: 155, 156).

Information asymmetry: A knowledge gap between the agency and regulated parties can lead to information asymmetry, a situation where the agent knows more about the task its performing for the principal than the principal themselves. This information asymmetry is a power imbalance that can be abused by the agent to their advantage. Evidence for presence of information asymmetry between Boeing and the FAA, includes the multiple instances where Boeing ARs did not inform the FAA of the full nature of the MCAS system by not emphasizing it as a 'new function' with cost being the main factor (US House Committee on Transportation and Infrastructure, 2020: 15). A significant example of this is the fact that Boeing failed to inform the FAA about the catastrophic nature of an MCAS induced emergency and the pilot response time needed to make the emergency controllable (US House Committee on Transportation and Infrastructure, 2020: 16, 114, 116, 207, 208). The House report argues that the many instances where Boeing ARs elected not to inform the FAA about the 737 MAX design diminished the agency's ability to properly oversee the 737 MAX certification (US House Committee on Transportation and Infrastructure, 2020: 16). In another instance the FAA approved a redesign of MCAS and the removal of MCAS from the 737 MAX pilot training module, but the people who approved the removal of the MCAS reference were unaware of the MCAS redesign (US House Committee on Transportation and Infrastructure, 2020: 20, 98, 119). The problematic pilot reaction time was only discovered by the FAA after its own internal review of MCAS after the Lion air crash, unfortunately this report was not finalized before the crash of the Ethiopian Airlines 737 MAX (US House Committee on Transportation and Infrastructure, 2020: 31).

Poor communication: FAA officials argued that under the ODA system, the FAA's ability to gain information about aircraft designs was limited (US House Committee on Transportation and Infrastructure, 2020: 70). The communication between Boeing ARs and the FAA is described as problematic in the House report (US House Committee on Transportation and Infrastructure, 2020: 75, 105). Boeing deliberately described the MCAS system as a minor adjustment to the existing speed-trimming system on the 737, which contributed to a flawed understanding of MCAS by the FAA (US House Committee on Transportation and Infrastructure, 2020: 93, 99). The FAA internal review of the 737 certification review revealed that the documentation of the design by Boeing was so problematic, the FAA would still have struggled to gather a full picture of the aircraft design if Boeing had been transparent to the FAA (US House Committee on Transportation and Infrastructure, 2020: 94). Further extensive

changes to MCAS were never reported to the FAA, meaning the MCAS the FAA approved was no longer the same system (US House Committee on Transportation and Infrastructure, 2020: 151). The decision to keep the 737 MAX in the air after the Lion air crash was taken by an FAA administrator that lacked the knowledge to understand MCAS and in turn to make an informed decision about it (US House Committee on Transportation and Infrastructure, 2020: 213). To quote Robison (2021: 163): "The FAA's specialists, the Forrest Gump's, were shown analysis based on an earlier iteration of the software, Revision C. They got their bewildering "drawer full of paper," as one of the engineers had put it. But it was the wrong drawer."

The analysis has shown evidence for the presence of excessive delegation due to lack of supervisory power, excessive delegation due to lack of expertise, and presence of information asymmetry. The evidence for the existence of these causal mechanisms suggests the existence of sufficient condition C and sufficient condition D.

5.4 Safety Culture at Boeing

Describing the safety culture at Boeing involves looking at the source of issues, the severity, and the relevant actions of the stakeholders.

- Source of the safety culture problem: What was the main cause of the safety culture issue?
- Severity of the safety culture problem: How much does this safety culture issue affect safety?
- Actions of stakeholders: What actions did stakeholders take in context of the safety culture issue?

Hasty design process: The House report describes instances of Boeing favoring the speed of the design process over the safety of the design itself. This is demonstrated in Boeing hiding aspects of the MCAS system from the FAA, including issues caused by AOA disagree alerts, the impact of MCAS, labelling MCAS as an existing system, and the pilot response time in case of an MCAS related malfunction (US House Committee on Transportation and Infrastructure, 2020: 13, 15, 16). Boeing's need to rush the certification in order to restart 737 production after the crashes and grounding was mentioned in internal FAA emails (US House Committee on Transportation and Infrastructure, 2020: 81).

Schedule pressure: Schedule pressure made it so that Boeing employees were on a clock to keep the design and production process of the MAX 'on track', with more importance on making the deadlines rather than the safety of the aircraft itself (US House Committee on Transportation and Infrastructure, 2020: 17). Project managers even received stocks as a reward for staying on schedule (US House Committee on Transportation and Infrastructure, 2020: 18). Supervisors expressed their concern about safety due to the production and schedule pressures, arguing that even the smallest defects can jeopardize the safety of an aircraft to a severe degree (US House Committee on Transportation and Infrastructure, 2020: 18). The house report describes a phenomenon known as 'out of sequence work', which describes a production process where the construction of the plane becomes disjointed due to delayed delivery of aircraft parts, this disjointedness leads to higher risk of construction errors (US House

Committee on Transportation and Infrastructure, 2020: 167). Senior company employee Ed Pierson raised his concerns about the effect of fatigued employees at the production lines (US House Committee on Transportation and Infrastructure, 2020: 175). Nevertheless, the for profit aspect of the company was argued to be too important and thus the production rate kept rising and the pressure on the employees kept growing (US House Committee on Transportation and Infrastructure, 2020: 18, 173).

Focus on profits: The House report describes how distraught engineers were with the shifting goals of the company from an engineering paradise with focus on safety to strictly a business where only the bottom line mattered (US House Committee on Transportation and Infrastructure, 2020: 37). One prominent senior employee of the company, Ed Pierson, was worried about the repeated dismissal of his warnings about the issues with Boeing's production process (US House Committee on Transportation and Infrastructure, 2020: 174). He ended up quitting 5 years before his predicted retirement (US House Committee on Transportation and Infrastructure, 2020: 174). The two accident aircraft from Lion air and Ethiopian Airlines were produced around the time that Pierson was most prominently raising his safety concerns (US House Committee on Transportation and Infrastructure, 2020: 178).

Cutting costs: Boeing's focus on cutting costs was described as another cause for the eroding safety culture of the company. Engineers were shut down when raising issues regarding either changing existing aircraft systems or adding new aircraft systems (US House Committee on Transportation and Infrastructure, 2020: 18). Severe instances include declining the use of synthetic/back up airspeed indicators in the 737 MAX that would have given the aircraft airspeed readings to fall back on if the primary system failed (US House Committee on Transportation and Infrastructure, 2020: 18).

Poor communication: The House report describes a company with dysfunctional communication between the work floor and upper management, illustrated by the lack of awareness about the omission of an AOA disagree alert on the 737 MAX, an indicator that could have alerted the pilots of the doomed planes about the faultiness of the sensor readings (US House Committee on Transportation and Infrastructure, 2020: 137). This lack of awareness was caused by an unwillingness to report safety issues at Boeing (US House Committee on Transportation and Infrastructure, 2020: 137). The communication issues were specifically addressed by Ed Pierson as one of the sources of the production issues the company was experiencing (US House Committee on Transportation and Infrastructure, 2020: 180).

Ignoring employee concerns: Raising issues within the company was described as difficult due to risk of retaliation against those that were brave enough to blow the whistle (US House Committee on Transportation and Infrastructure, 2020: 172). The House report describes a culture with a suppressive attitude towards safety issues, especially concerning aircraft accidents (US House Committee on Transportation and Infrastructure, 2020: 172). Ed Pierson stated that he had heard from other experienced employees that the production process of the 737 had never been as poor as around the time of the 737 MAX accidents (US House Committee on Transportation and Infrastructure, 2020: 180). Areas outlined by Pierson included (US House Committee on Transportation and Infrastructure, 2020: 180, 181):

- Employee Fatigue & Schedule Pressure
- Leadership Actions & Inactions
- Quality Issues
- Supply Chain Disruptions
- Staffing Constraints
- Process Deviations
- Communication Breakdowns
- Safety Incidents
- Functional Test Delays & Failures
- Facility Limitations
- Equipment Shortcomings
- Recovery Planning Efforts
- Deteriorating Factory Health Metrics

On multiple occasions Ed Pierson raised these concerns to Boeing's board of directors, but he fell on deaf ears every single time (US House Committee on Transportation and Infrastructure, 2020: 182).

Undue influence: Boeing ARs experienced undue pressure while conducting their supervisory activities for Boeing during the 737 MAX design process (US House Committee on Transportation and Infrastructure, 2020: 15). Members of the ODA committee, in a Boeing internal survey, in particular outlined the dual role they had as Boeing employees and FAA designees, which led to both pressure from Boeing and conflicting interests in general Boeing ARs experienced undue pressure while conducting their supervisory activities for Boeing during the 737 MAX design process (US House Committee on Transportation and Infrastructure, 2020: 185, 186).

The House report describes a company that deteriorated due to a shift in values, away from perfectionism, and safety focus that was lauded by founder Edward Boeing (US House Committee on Transportation and Infrastructure, 2020: 229). This ultimately led to a culture where employees did not feel encouraged to report safety issues (ICAO, 2018: 3-3):

- There was no incentive among management to take actions and decisions in order to promote safety. Priority was given to speeding up production, putting profits over safety.
- The poor communication inside Boeing made healthy criticism and reporting concerns very difficult.
- There was no common awareness of risks between management and staff, as illustrated by the continuous ignorance shown towards the concerns of employees such as Ed Pierson.
- Decisions were made under the notion that profit and production rate were more important than safety.
- The company did not value being informed, there was a fear of retaliation if safety concerns were reported.

6. Conclusion

A colluding regulator: The discretion the FAA has to so set prudential regulation, taking into account the lack of influence of congress and the NTSB, points to a problematic state of regulatory independence. This could lead to an FAA focused too much on industry growth and too little on safety (Robison, 2021: 119). A regulatory agency that is more concerned about industry growth as opposed to safety, is at a high risk of being captured by industry (Quintyn & Taylor, 2002).

The analysis has pointed out the collusion between the FAA and Boeing, and the lack of congressional influence over FAA regulations. The evidence for both the collusion between the FAA and Boeing, and the lack of influence congress has on regulation, form evidence for the existence of regulatory capture. Whether regulatory capture is caused by the FAA's state of regulatory independence is answered by the constitution: the same section that outlines the FAA's freedom when making prudential regulation implies the lack of influence congress has over the execution of its legislation by the FAA, the FAA's described regulatory independence implies the lack of congressional influence (US constitution ch1 sec106, 2021: 28). Using the theory on regulatory capture described in the paper, one can argue that the collusion between the FAA and Boeing can lead to the regulatory capture of the FAA if there is no counterinfluence on the agency with the public interest in mind. Since the evidence for the existence of congressional influence argues that the Congress, the voice of the public interest, does not have the influence to counter industrial influence on the FAA because of the power of the FAA administrator, the argument can be made that the FAA is a captured regulator.

An intrusive government: The analyzed literature shows evidence of governmental interference with the governance structure of the FAA and the terms of appointment and dismissal of the FAA. Using the theory, it can be argued that this governmental interference could lead to a risk of regulatory capture. The terms of appointment and dismissal are often tied to industrial interests (MITRE, 2020), suggesting the occurrence of regulatory capture of the FAA by Boeing. Using the theory the state of institutional independence can be deemed inadequate due to consistent interference with the agency by both the executive and legislative powers, and industrial parties, leading to risk of regulatory capture.

The analysis has provided evidence that FAA officials appointed by the US government are industry favoring and has provided evidence of employees and officials travelling through a revolving door between the FAA and Boeing or related parties. The evidence for the presence of industry favoring officials, and a revolving door, form evidence for regulatory capture. Whether regulatory capture can be traced back to the FAA's state of institutional independence can be argued with the US Constitution, which states that the FAA Administrator, Deputy Administrator and 10 members of the Advisory Council are appointed by the President with the advice and consent of the Senate (US constitution ch1 sec106, 2021: 27, 31). It was the decision of the president and the senate to appoint industry favoring officials, and the FAA did not have the authority to influence the appointment of these positions and select a less industry favoring candidate. Evidence for whether the FAA was captured through Boeing's acquired knowledge

of the FAA's regulatory practices was not found in the analyzed literature. The literature relating to Condition B did show evidence that industry favoring officials and the revolving door stimulated regulatory capture more akin to the situation described in the analysis of condition A.

A captured agency: Regulatory capture negatively affected the FAA's ability to oversee Boeing during the development of the 737 MAX. It is the FAA's responsibility to ensure a safe airspace in the United States and ensure the aircraft coming out of the United States are safe. The FAA failed to oversee Boeing's activities and safety culture as shown by how poor the state of Boeing's safety culture was. The House report traces the safety issues back to the capture of the FAA (US House Committee on Transportation and Infrastructure, 2020: 6).

To quote the House report (2020: 6): "The MAX crashes were not the result of a singular failure, technical mistake, or mismanaged event. They were the horrific culmination of a series of faulty technical assumptions by Boeing's engineers, a lack of transparency on the part of Boeing's management, and grossly insufficient oversight by the FAA—the pernicious result of *regulatory capture* on the part of the FAA with respect to its responsibilities to perform robust oversight of Boeing and to ensure the safety of the flying public."

The analysis traces the regulatory capture back to the collusion between the FAA and Boeing, which could not have occurred without the regulatory independence the FAA had from the US government. This traces the negative safety culture at Boeing back to the FAA's 'independence as a regulator'.

A toothless regulator: The literature paints a picture of an inadequate state of the supervisory independence of the FAA, which according to theory could lead to principal-agent problems between the FAA and Boeing through a lack of supervisory power to govern such a potential relationship effectively through covering transaction costs.

Evidence that a principal-agent problem traces back to supervisory independence can be found in the MITRE survey, where FAA employees voice concerns that under the US constitution title 49 the FAA has excessively delegated supervisory responsibility to Boeing, which would imply excessive delegation traces back to the FAA's state of supervisory independence (MITRE, 2020: 7). The survey delves deeper into this, suggesting that under the ODA program adapted under US constitution title 49 the FAA has a lack of licensing power and that this puts it at the mercy of the company it is supposed to supervise, it suggests the FAA is dependent on Boeing's cooperation to carry out its certification responsibilities (MITRE, 2020: 33). Using the theory on the principal-agent problem, the argument can be made that the evidence for excessive delegation suggests a principal-agent relationship where the FAA is dependent on Boeing's information provision to adequately supervise and certify the Boeing 737 MAX, and that the presence of information asymmetry between the FAA and Boeing could lead to a situation where the FAA is not able to cover the high transaction costs of the principal-agent relationship between the FAA and Boeing that come with a lack of oversight due to lack of licensing power and supervisory power in the strict sense (US House Committee on Transportation and Infrastructure, 2020: 14, 233).

A poor regulator: Despite the evidence in the constitution regarding the independence of personnel recruitment, other evidence suggests the FAA's personnel recruitment is negatively affected by the lack of influence over the agencies' budget. Using the theory, it can be argued that this state of budgetary independence is inadequate and could lead to principal-agent problems between the FAA and Boeing through a lack of expertise to govern the relationship effectively by covering transaction costs.

Evidence that a principal-agent problem traces back to budgetary independence can be found in the MITRE survey. The lack of human capital and staffing challenges are discussed, reasoning that the FAA struggles to compete with the pay that other organizations can offer employees (MITRE, 2020: 7, 38). Robison argued that staffing challenges came forth out of a budget that was held flat from 1996 through 2012, suggesting that the staffing challenges traced back to a lack of budget to offer competitive salary which traced back to the FAA's lack of authority over its own budget (Robison, 2020: 121). Using the theory on the principal-agent problem, the argument can be made that the evidence for excessive delegation suggests a principal-agent relationship where the FAA is dependent on Boeing's superior expertise regarding the design of the 737 MAX in order to understand the design and certify the aircraft, and that the presence of information asymmetry between the FAA and Boeing could lead to a situation where the FAA is not able to cover the high transaction costs of the principal-agent relationship between the FAA and Boeing that come with a lack of understanding of the design due to lack of necessary expertise which is caused by a lack of authority over the budget (US House Committee on Transportation and Infrastructure, 2020: 233).

A blind agency: The FAA delegated large amounts of the certification and oversight processes to Boeing themselves, but was unable to oversee these process due to principal-agent problems between the FAA and Boeing, expressed through the FAA's inability to supervise in the strict sense, inability to sanction, lack of licensing power, and a lack of expertise. The continued delegation through the ODA program coincided with the development of a negative safety culture at Boeing (US House Committee on Transportation and Infrastructure, 2020: 54).

The ODA oversight structure left the FAA open to being taken advantage of through information asymmetry. The communication between the FAA and Boeing within their principal-agent relationship was characterized by withheld information about the 737 MAX design process, and undue pressure on Boeing ARs (US House Committee on Transportation and Infrastructure, 2020: 75, 233).

The analysis traces the principal-agent problems back to the excessive delegation of oversight by the FAA to Boeing, which could not have occurred without the state of supervisory independence and the state of budgetary independence of the FAA from the US government. This traces the negative safety culture at Boeing back to the 'independence of the FAA as a regulator'.

7. Discussion

The FAA's state of independence contributed to:

- The regulatory capture of the FAA by Boeing
- The principal-agent problems between the FAA and Boeing

Both regulatory capture and the principal-agent problems contributed to the FAA's failure to oversee Boeing. This contributed to the development of a negative safety culture at Boeing: Safety issues went unnoticed. This ultimately contributed to the crashes with the 737 MAX aircraft.

The hypotheses described in condition A, C, and D were confirmed in the analysis. Condition B, regulatory capture caused by appointment of industry favoring officials that traveled through the revolving door from the FAA to Boeing, could not be sufficiently proven due to the fact that there was no evidence in the literature that industry practices were shared. However, the low institutional independence of the FAA showed evidence of causing regulatory capture in a very similar way to how high regulatory independence caused regulatory capture: collusion. Thus this still provided useful information to answer the research question with. The 4 dimensions of agency independence by Quintyn and Taylor (2002) presented themselves as expected. The state of independence of the FAA across regulatory, institutional, supervisory, and budgetary independence correlated with regulatory capture and principal-problems as theorized. The House report painted a picture of an agency that was both uninterested and at the same time unable to do the right thing, which was oversee Boeing with the public interest at heart.

The results relating to condition B show an interesting difference between the theory of Quintyn & Taylor (2002) and the actual representation of the institutional independence of the FAA. The expectation was that the negative effect of appointing industry favoring officials would only negatively affect FAA oversight due to the existence of the revolving door. However, the research showed that the presence of industry favoring officials alone were more than enough to cause corruption of the FAA's oversight of Boeing. If there was a revolving door, it was a wider revolving door between the aviation industry and the US government which bled through to the FAA. In other words, most of the traffic through the revolving door was from industry to regulator. Not the other way around. That might have contributed to the decline of FAA oversight. This unexpected finding should be a motivation for future research into the role of institutional independence specifically.

The results as a whole serve as a practical example of the importance of independent regulators. The results matter because regulators are there to serve the public interest first and foremost. The results of this study are a real-life manifestation of the FAA's ability to act on its own: the negative safety culture could be traced back to the independence of the FAA as a regulator (Downer, 2010). The state of this independence has shown to be very important due to the consequences an inadequate state of agency independence can have; the state of the four different dimensions, whether the FAA had lots of separation from the industry and government, or none at all, had different effects depending on the dimension. This outcome of the research strengthens Downer's claims (Downer, 2010). How regulatory capture and principal-agent problems traced back to the inadequate state of independence across the four dimensions

reinforces the work by Hoppe (2019) and Nunn (2020); The FAA's relationship with the industry and government was one of collusion and interference, which negatively affected the effectiveness of the agency; Excessive delegation, which Nunn (2020) deemed problematic, could be traced back to the dimensions of supervisory independence and budgetary independence.

The results of this study, which uses causal process tracing, are only relevant to this particular study; the research was designed around the case of the 737 MAX accidents, it is a within-case methodology (Beach & Reykers, 2017: 274). This is not to say that CPT cannot be used in other studies which try to explain historical events and the role of agency independence in those historical events; it means that depending the historical event, agency independence would express itself throughout different causal mechanisms, which is why a study attempting something similar to this study would have to write its own methodology (Beach & Reykers, 2017: 274). It means that the methodology of this study cannot not be used for more than one case (Beach & Pedersen, 2013: 88). An example could be the 787 battery fires or the Alaska Airlines door plug blowout in 2024: While relevant to the safety culture at Boeing, the causal mechanisms would not be fitting anymore if you were to combine these two historical events with this study. This study is specific to the 737 MAX accidents, the evidence and inferences made through the literature used in the study are only used for conclusions based around that specific case (Beach & Pedersen, 2013: 89). If the CPT method of this were to be used for multiple cases at once, it would no longer be a valid study (Beach & Pedersen, 2013: 89)

Further research into the four dimensions of independence as described by Quintyn & Taylor (2002) that better relates to regulatory agencies in industry would be very relevant. The main motivator for this should be public safety. Any industry involving the selling of physical products, which concerns the health and safety of citizens, should have extra emphasis on having a regulator with an adequate amount of independence. It is very relevant for governments, and responsible as well, to carry out research into for example the independence of food, transport, or energy sector regulators. This study mainly focused on capture of the FAA by Boeing, less so on the capture of the US government by Boeing through lobbying, subsequently influencing the FAA. This briefly came up during the discussion of institutional independence but deserves more attention in its own study.

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