BLOCKCHAIN TECHNOLOGY FOR GUN REFORM

EVALUATING THE ATF'S DATABASE CHALLENGES THROUGH ACTOR-NETWORK THEORY

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction:

The number one killer of children and teens in the U.S. is firearms (Villarreal et al., 2024). This fact is widely recognized by policymakers, parents, and schools alike, yet very little has been done to address it, due to the current political landscape surrounding gun reform. The NRA does not support any form of gun control, stating that such legislation "paves the way for additional gun control that will only infringe on the rights of the law-abiding" (NRA, n.d.). Despite opposition from the NRA and certain members of Congress, efforts to address this problem persist. For instance, the 2022 Bipartisan Safer Communities Act mandated licensing for individuals selling guns primarily for profit, aiming to curb illegal gun sales by empowering the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) to regulate such transactions (United States Department of Justice, 2024).

In addition to new regulations, many engineers have developed technologies to address gun violence, such as SmartGuns, microstamping, and ShotSpotter. However, to significantly reduce gun violence and make schools safer, both policymakers and engineers must focus on addressing gun tracking and illegal firearm sales.

Because the challenge of gun violence is socio-technical in nature, it requires attending to both its technical and social aspects to accomplish successfully. In what follows, I set out two related research proposals: a technical project proposal for developing an advanced blockchain system to modernize firearm tracking and an STS (Science, Technology, and Society) project proposal for examining the social factors underpinning the inefficiencies of the current ATF database. These projects will collectively address the complex socio-technical problem of gun violence, integrating technological advancements with a nuanced understanding of their societal impact.

Technical Project Proposal:

All firearms manufactured, sold, and used in the U.S. through a licensed gun distributor must be registered with the ATF. This system has been in place since the 1980s and in 1986 “congress passed a ban on the ATF ever having a so-called federal gun registry or any kind of electronic database of firearms” (Moone, 2023). This has resulted in an archaic record-keeping system that results in delayed reports for law enforcement and little awareness of how many guns are circulating the U.S. When a potential gun owner decides they would like to buy a firearm, they must fill out a 4473 form, a basic background check, that is then sent to the NICS to be approved. If this form is not approved within three days by the NICS, it is automatically approved. Once the gun is sold to said owner, their 4473 form is signed off by the Federal Firearms License (FFL) seller, and both the FFL seller and the ATF hold onto physical copies of this document. This documentation method would be efficient at an incredibly small scale, but in 2023, 15.9 million firearms were sold in the U.S. - this number is expected to only increase in the coming years (Cassidy, 2024). This highlights the need for a proper documentation system to improve the safety of U.S. citizens from gun violence.

To address the deficiencies of the ATF’s current database system, technologies like SmartGuns have been developed in recent years. SmartGuns are firearms that have either a fingerprint or face scan system that requires users to “open” the gun in order to use it. This technology is intended to prevent specifically gun accidents with children, firearm theft, and teen suicide to name a few. While the SmartGun technology is incredibly impressive and advanced, it is unrealistic to expect that every gun owner makes this type of investment (Cusick, 2022). There are several other technologies that also aim to prevent certain aspects of gun violence, but at the end of the day, they all fall into the same category as SmartGuns, costly and unrealistic. This is

why I think it is important to focus on improving the system already in place, the ATF database system.

The project I will be embarking on will focus on modernizing the ATF database system through the implementation of blockchain technology - to create immutable digital records for firearm sales, automated compliance, resources for law enforcement, and increased privacy for gun owners. Blockchain technology is by nature trustworthy and private, with the ability to track important information about firearm transactions. IBM defines blockchain as “ideal for delivering information because it provides immediate, shared, and observable information that is stored on an immutable ledger that only permissioned network members can access” (IBM). The first step of this project would be to develop the technology specifically for firearm sales. Through working alongside several cybersecurity professionals and experienced blockchain developers, the team would design a secure, permissioned blockchain tailored to the ATF’s needs. This blockchain system would include encrypted nodes and smart contracts capable of validating compliance data, with strict privacy measures to protect sensitive information. The initial prototype would focus on functionality such as transaction tracking, data entry for background checks, and automated compliance checks, all designed to integrate seamlessly with the ATF’s existing workflows. The next step of the project would involve testing the technology out on a small network of licensed firearm providers. This pilot program would allow the selected firearm providers to input important data such as the gun owner’s 4473 form, background checks, date of purchase, and type of weapon purchased at the time of a sale. If this setup proves to be successful for the small cohort of firearm providers, then I could work alongside the ATF to roll it out to the public.

STS Project Proposal:

The ATF's current database system for firearm transactions relies on outdated, paper-based records and decentralized documentation processes, which hinder its ability to effectively trace firearms used in crimes, track illegal transactions, and monitor licensed gun sellers (Cohen, 2024). This inefficiency is rooted in a 1986 law prohibiting the creation of searchable records of firearm sales. Currently, tracing a firearm used in a crime takes 12 to 14 days on average, significantly delaying investigations and allowing illegal firearms to circulate longer (NBCUniversal News Group, 2022). These inefficiencies result in public safety risks and frustrate law enforcement efforts to act swiftly. My research focuses on analyzing the failure of the ATF's record-keeping system to function as an effective technical network for firearm tracking and investigating the causes of this failure through Actor-Network Theory (ANT). Existing perspectives on the ATF's database challenges primarily emphasize regulatory and policy constraints, such as privacy concerns and political resistance to centralized digital databases. These analyses focus heavily on the impact of the 1986 law and the inefficiencies of a fragmented, paper-based system but often treat these factors in isolation. While these studies highlight critical issues, they fall short of addressing the complexity of interactions among various human and non-human actors involved in the system.

The current approach is inadequate because it overlooks the broader interplay of actors that form the ATF's technical network. Regulatory and policy analyses often fail to incorporate how other key actors—such as licensed gun distributors, physical database systems, and record storage policies—interact within this network. This gap leaves unanswered questions about why the ATF's system remains fragmented despite the involvement of multiple stakeholders and technologies. Moreover, these perspectives fail to apply a framework like ANT that captures the

dynamic relationships between human and non-human actors, revealing systemic weaknesses in the network's design and operation.

By adopting an ANT framework, my research will provide a new understanding of the ATF's database failure as a breakdown of actor-network alignment. Without this perspective, readers miss the opportunity to see how the failure stems not just from regulatory constraints but from broader issues in network translation, including weak integration among stakeholders and resistance from key actors like the NRA. This understanding is crucial for appreciating the interconnected challenges faced by the ATF in modernizing its systems.

Using Actor-Network Theory, I argue that the ATF's firearm transaction database failed because network builders, including the ATF and policy-makers, could not effectively enroll and align human and non-human actors into a cohesive network. This failure is evident through Michel Callon's concept of translation, which highlights breakdowns in the processes of aligning actors' interests. Privacy concerns, political resistance, and technological fragmentation prevented the creation of a centralized digital system, resulting in a disjointed network that cannot meet its intended purpose.

Actor-Network Theory (ANT) provides the foundation for my analysis, emphasizing the interconnectedness of human and non-human actors within a network. ANT examines how the relationships among these actors determine a network's strength or success (Cressman, 2009). In this case, Michel Callon's concept of translation will be central to understanding how the failure to enroll key actors—such as policy-makers, licensed gun distributors, and the database infrastructure—led to the fragmentation of the ATF's network. The framework allows me to analyze both human (e.g., the ATF, gun owners, distributors, and policy-makers) and non-human (e.g., the database system, 4473 forms, and record storage policies) actors within the system.

To support my analysis, I will draw upon a combination of news articles detailing inefficiencies in the ATF's record-keeping system, public records on firearm tracing and database operations, and academic literature on ANT and translation processes. These sources will help illustrate how misaligned actors and systemic weaknesses contributed to the network's failure.

Conclusion:

In conclusion, the ATF's record-keeping system illustrates the consequences of weak socio-technical networks. Through the lens of Actor-Network Theory, this project identifies how regulatory constraints, fragmented documentation, and misaligned actor interests undermine firearm tracking and public safety efforts. The proposed blockchain-based digital system offers a practical solution, enabling faster firearm traces, reducing illegal gun circulation, and ensuring compliance with privacy regulations. By integrating technical innovation with a deeper understanding of societal dynamics, this project contributes to both the advancement of gun safety technologies and the broader field of socio-technical systems analysis. Additionally, it highlights the importance of collaboration among stakeholders, emphasizing how coordinated efforts between policymakers, engineers, and law enforcement agencies can address systemic inefficiencies. This synthesis of technology and policy showcases a pathway toward not only improving public safety but also establishing more robust and adaptable socio-technical infrastructures for future challenges.

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