An Enterprise Network Model for Understanding and Disrupting Illicit Counterfeit Electronic Part Supply Chains

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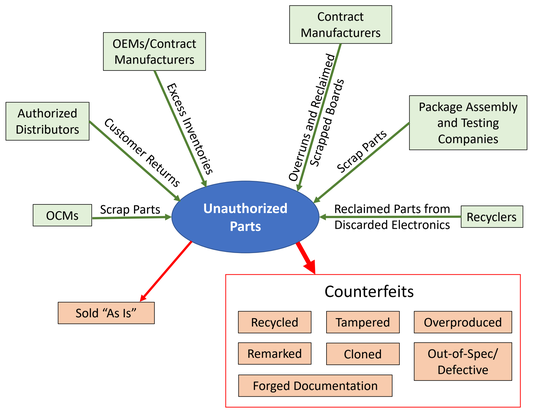
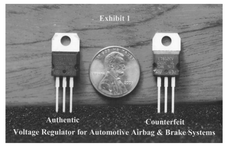
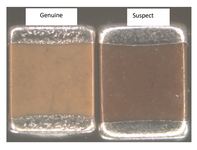
What is a Counterfeit Electronic Part?

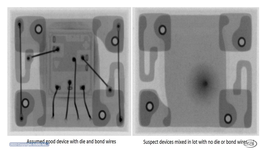
Fraudulent or unauthorized reproduction, substitution, or alteration that has been knowingly mismarked, misidentified, or otherwise misrepresented to be an authentic, unmodified electronic part from the original manufacturer, or a source with the express written authority of the original manufacturer or current design activity, including an authorized aftermarket manufacturer (SAE, AS5553-D, 2022).

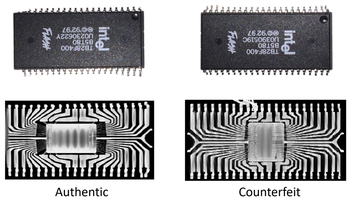


- Used or refurbished parts
- Recycled parts
- Copycat parts
- Overproduced parts
- Altered date codes: Parts with altered date codes to mispresent vintages, such as to make them appear newer than they actually are.
- Incorrect markings: Components that have been marked with incorrect part numbers, logos, or other identifying information to make them appear to be genuine parts.
- Non-conforming parts: Parts that do not meet the specifications of the original manufacturer but are passed off as authentic.
- Misrepresented parts: Parts labeled and marketed as one thing but are something else entirely.









Motives (Why Do People Counterfeit Electronic Parts?)

Financial gain is the primary motivation. However, more clandestine motives by nation-states can potentially harm national industry and defense capability.

Who Cares?

The supply chain needs to be stable for 18-24 months to support this.

- All parts are procurable from their original manufacturers and through authorized channels
- Counterfeit electronic parts are extremely rare

The supply chain needs to be stable for 30+ years to support this.

- After the original manufacturer discontinues the part, it is only available from unauthorized channels
- When parts become obsolete (non-procurable), counterfeiters may step in to fill the void
- Safety-critical, highly qualified and certified systems that can only be supported with the original parts (no room for error)

Counterfeit Electronic Part Avoidance Strategies Today

Today, counterfeit electronic part avoidance relies on detection methodologies and authentication-enabling technologies through tracking and traceability; relatively little attention has been paid to modeling the networks responsible for creating and distributing counterfeit electronic parts.

Research Objectives

Create an enterprise network model to understand the dynamics and test the efficacy of policies and technologies for reducing the prevalence of counterfeit electronic parts and predicting unintended consequences.

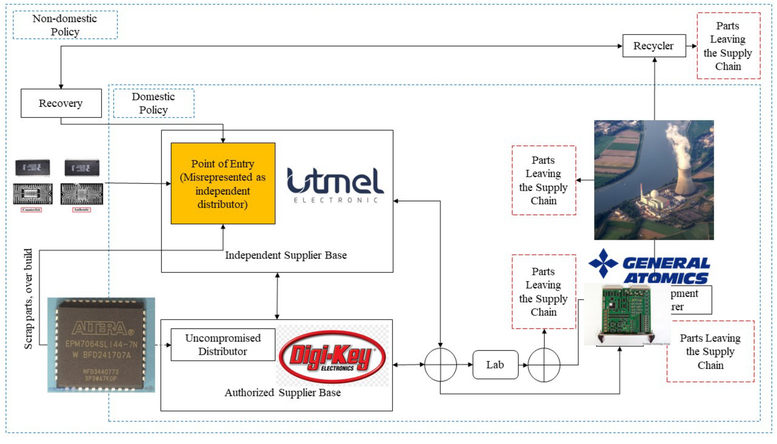
What is Enterprise Network Modeling?

Supply-chain networks are comprised of decision-making social bodies such as individuals, companies and technological artifacts such as infrastructure and manufacturing facilities. Example: the transaction of goods between two companies to generate profit with regulations/contracts that constrain the process.

Agent-Based Modeling and Policy Analysis

An agent-based model is a model for simulating the actions and interactions of independent and autonomous agents with their own decision-making capabilities used to understand a system's behavior and what governs its outcomes. Agents can be humans, companies (e.g., suppliers), policy makers. It is a bottoms-up approach for modeling complex systems that is commonly used to model social networks (less common in engineering).

- Profit maximization is the primary objective of the agents in the supply chain.
- An agent's desire to maintain its business reputation and to avoid penalties associated with exchanging counterfeit parts is captured through profit maximization.
- The profit horizon can be short term (single transaction) or long term (multi-program).

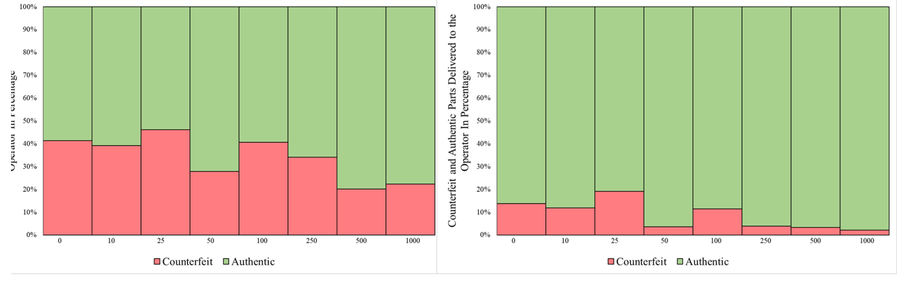


Policy Analysis

Debarment of companies from participation in the supply chain for a certain amount of time is one of the major policy tools currently used in the industry to penalize counterfeit part sellers. We examined the effects of debarment time duration on the prevalence of counterfeit parts in different stages of the supply chain

Example Results

Enforcement of debarment during active production does not reduce risk but has costs. It should be only enforced for obsolete parts to maximize counterfeit vs. resources.



Future Directions

Blockchain for supply chain has received a lot of attention and claims to be a solution for counterfeiting issues. We are using the model to study the effectiveness of blockchain for supply chain for aging supply chain systems.