

Software Supply Chain Security of Power Industry Based on BAS Technology

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Abstract—The rapid improvement of computer and network technology not only promotes the improvement of productivity and facilitates people's life, but also brings new threats to production and life. Cyberspace security has attracted more and more attention. Different from traditional cyberspace security, APT attacks on key networks or infrastructure, with the main goal of stealing intellectual property, confidential information or sabotage, seriously threatening the interests and security of governments, enterprises and scientific research institutions. Timely detection and blocking is particularly important. The purpose of this paper is to study the security of software supply chain in power industry based on BAS technology. The experimental data shows that Type 1 projects account for the least amount and Type 2 projects account for the highest proportion. Type 1 projects have high unit price contracts and high profits, but the number is small and the time for signing orders is long.

Keywords—BAS technology, power industry, power software, supply chain security

I. INTRODUCTION

With the continuous improvement of the information age, the Internet economy has become one of the pillar industries of global economic improvement, leading the continuous innovation of science and technology. As one of the achievements of this era, information products are not only meeting people's growing needs, but also constantly stimulating people to have new expectations [1]. In software

enterprises, project management will also be involved. How to combine project management with system certification to establish a scientific and feasible software project management process that can both meet the certification requirements and be implemented has become the key.

In today's society, the information industry has entered a stage of rapid improvement, and the application of software products has gradually expanded in scope. All industries have increasingly strengthened demand and dependence on software, so the importance of software quality management has received extensive attention. Akulichev V O studied the ability to monitor the physical and mental conditions of employees of the power grid company based on multi-agent, predicted and analyzed the human risk of energy production within the framework of the risk-based human resource management method, and reviewed the information and analysis technology implemented during the operation of the power grid. The analysis includes instrument monitoring and indicator evaluation (using objective data). These indicators describe the actual technology and business process of the operation manager, operation and maintenance personnel participating in the service equipment of the network company. The optimization theory method, fuzzy set, index analysis, data analysis and data analysis are used to provide comprehensive information to the operation manager and management of the energy company to solve the problem of wrong actions Based on the optimization problem of minimizing damage caused by inaction and violation of

energy production safety requirements, suggestions are made on the investment field of human resources improvement. It is suggested to use the dimensionless index system to evaluate the situation of the staff, predict and analyze the success of their professional activities, and form their ontology model to manage human risks, ensure the reliable and safe operation of energy production, and possibly improve measures and scenarios that affect the staff during the production process. The method of forming monitoring technology is proposed to ensure the establishment of a unified system, record the status of power facility staff, count the failures caused by staff failures, determine the best type, composition and cost of impact on staff, improve their health based on multi-agent analysis of monitoring data, and allow the flow of events to be guided according to the conditions set by the availability of funds for these purposes [2]. Maleki M G induction motors are widely used in industry. The transient component of the short circuit current will cause the operating time of the overcurrent relay to change, and lead to the incompatibility between the main relay and the standby relay. Therefore, the traditional relay coordination method using fixed short-circuit current for specific fault location is not suitable for industrial power grids. The action of the induction motor may cause the non directional overcurrent relay of the normal feeder to trip by mistake. A method based on the dynamic model of overcurrent relay is proposed to consider the influence of the transient component of short-circuit current in relay coordination. In order to solve the problem of false tripping, A new set of constraints has been added. In this case, an optimization algorithm is needed to coordinate the unidirectional overcurrent relay [3]. Once the power industry is short of supply it will affect the security of power supply and will cause a wide range of power supply tension. It has brought huge losses to the national economy and people's lives.

According to the background and significance of the research, this paper studies the power supply chain security and BAS technology, including APT attacks. In the experiment, by introducing the company and using the key node identification technology of the power communication network, the author investigated and analyzed the competitive environment of the power industry software market and the capacity and characteristics of the power industry software target market.

II. RESEARCH ON SOFTWARE SUPPLY CHAIN SECURITY OF POWER INDUSTRY BASED ON BAS TECHNOLOGY

A. Background and Significance of the Study

The electric power industry is the basic industry of the national economy, and the safety, stability and adequacy of the electric power supply is an important prerequisite for the healthy, stable, sustainable and rapid development of the national economy, and the development level of the electric power industry has become an important indicator of the economic and cultural level of a country. At present, the proportion of thermal power in the total installed power in China is above [4]. Due to the large proportion of thermal power units, power supply is still the main factor limiting the security of power supply. However, due to the adjustment of China's electricity policy in recent years, the frequent occurrence of climatic disasters and the impact of the world economic crisis, the production and transportation of electricity have been seriously affected, and the fluctuation

of demand has caused a shortage of electricity, which has led to an increase in electricity prices, resulting in increased operating costs, losses and reduced power supply for power generation enterprises, and finally, the security of electricity supply has been seriously affected. This paper studies the security of the software supply chain in the power industry based on BAS technology Ensuring the operating costs of power generation enterprises and large users and the stable inventory of power generation enterprises Effectively coping with power shortages and ensuring the security of power supply. The study of strategies to ensure the security of electricity supply has important value and practical significance [5].

B. Power Supply Chain Security

The power industry is a basic industry related to the enhancement of the national economy. From a supply chain perspective, the industry's main product is electricity, a public good essential to people's lives and production [6]. According to the main supply chain line of raw material supply, product production, sales and consumption, it can be roughly divided into coal supply, power generation, transmission, sale and consumption of electricity. The main task of the coal supply segment is to produce and transport the power coal required for electricity generation. The main members of this link are the coal companies. The main task of the power generation segment is to produce electrical energy products, and the main members of this segment are the power generation enterprises. The main task of the electricity transmission and sales chain is to transmit and sell electrical energy, and the main members of this chain are the grid companies. The main task of the electricity consumption chain is to consume the purchased electricity, and the main members of this chain are the electricity consumers.

According to the concept of supply chain in economic management Combined with the characteristics of the electric power industry, the concept of electric energy supply chain, through the control of coal, electric energy, capital and information, starts from the purchase of coal, through the power generation enterprises for power generation, grid enterprises for transmission, distribution and sale of electricity, and finally by the power users to use the overall network chain structure consisting of coal supply, power production, transmission, sale and consumption [7]. The time lag effect of production and transportation capacity due to national economic policies and climatic disasters, which make coal production and transportation an important constraint on the supply of electricity. Fluctuations in external uncertainty of electricity demand. Electricity demand outside the electricity supply chain often fluctuates due to climatic disasters and economic fluctuations, which will lead to increased volatility in demand in the electricity sector.

C. BAS Technology

1) Advanced Persistent Threats

Advanced Persistent Threat (APT) is a long-term network attack. An intruder can access the network and is not found for a long time. 8 APT attacks are usually aimed at monitoring network activities and data theft, rather than causing damage to networks or organizations. APT attacks typically target organizations in the defense, manufacturing, and financial sectors because these companies handle high-

value information, including intellectual property, military plans, and other data from government and business organizations. Some APTs are very complex and require full-time administrators to maintain vulnerable systems and software on the target network. The motivations of senior persistent risk participants vary. Organized criminal groups may launch high-level persistent threats to obtain information that can be used to criminal gain economic benefits [9]. Network security experts usually focus on detecting exceptions in outgoing data to see whether the network has become the target of APT [10].

2) Denial of service attack simulation

CERT Coordination Center issued a message to warn the public that a new type of attack, namely denial of service (DoS) attack simulation, has emerged. So what is a DoS attack? DoS attack can be defined as a special form of attack, which aims to destroy or deny legitimate users' access to networks, servers, services or other resources [11]. DoS attacks have various forms. This paper divides them into two basic forms: target resource scarcity type and network bandwidth consumption type. Resource deficient attacks only attack one target at a time, which aims to make the attacked host unable to continue to provide services for legitimate users. For example, legitimate users cannot access the FTP service normally. The target of bandwidth consuming attacks is the entire network, that is, to interrupt all legitimate access, including access in both input and output streams. This kind of attack will make the network full of a large number of false data, resulting in legal data can not be processed normally. In order to achieve this goal, attackers often need to use some means to generate a large number of data packets [12].

III. INVESTIGATION AND RESEARCH ON SOFTWARE SUPPLY CHAIN SECURITY OF POWER INDUSTRY BASED ON BAS TECHNOLOGY

A. M Company Profile

M Power industry software company is a listed company. Based on the power industry, the company is a professional power software product and solution provider. In the power industry, supporting software and products can be provided from the planning, design, construction and operation life cycle of each project, especially CGD photoelectric engineering software and CFD wind power engineering software package provided in the field of engineering design are in the leading position in the industry.

B. Key Node Identification Technology of Power Communication Network

After modeling the power system communication network, we use the key point identification technology of complex network theory to identify the key nodes of the power system communication network. Here, we use the

compactness intermediate index to measure the key nodes of power system communication network. For the node v_i in the power system communication network, the average distance between the node and other nodes in the power system communication network is calculated as follows:

$$D(v_i) = \frac{1}{n-1} \sum_{j \neq i}^n w_i \bullet g(v_i, v_j) \quad (1)$$

In the above formula, $g(v_i, v_j)$ represents the shortest distance between v_i and v_j , and w_i represents the weight value in the network. The compactness necessity is defined as the reciprocal of the average distance, as follows:

$$C(v_i) = n - 1 / \sum_{j \neq i}^n w_i \bullet g(v_i, v_j) \quad (2)$$

IV. ANALYSIS AND RESEARCH ON SOFTWARE SUPPLY CHAIN SECURITY OF POWER INDUSTRY BASED ON BAS TECHNOLOGY

A. Analysis of Software Market Competition Environment in Power Industry

There are about 50 power industry software providers in China. Due to the large-scale operation of the State Grid and China Southern Power Grid and the large geographical region, the branches of these companies are in the leading position in the power marketing software system and have a large proportion of the market share. Except for the affiliated companies of State Grid Corporation of China and China Southern Power Grid Corporation, there is no such powerful company in the current market. Therefore, other companies in the same industry have a small share in the market. The revenue of software in the power industry is shown in Table I and Figure 1:

TABLE I. SOFTWARE AND SOFTWARE SUPPLY CHAIN INCOME OF ELECTRIC POWER INDUSTRY

Company	Income (Unit: ten thousand yuan)	Market share%
A	84512	41.5
B	75481	35.7
C	65142	30.1
D	55841	27.2
E	48971	26.4
Other	10524	19.5

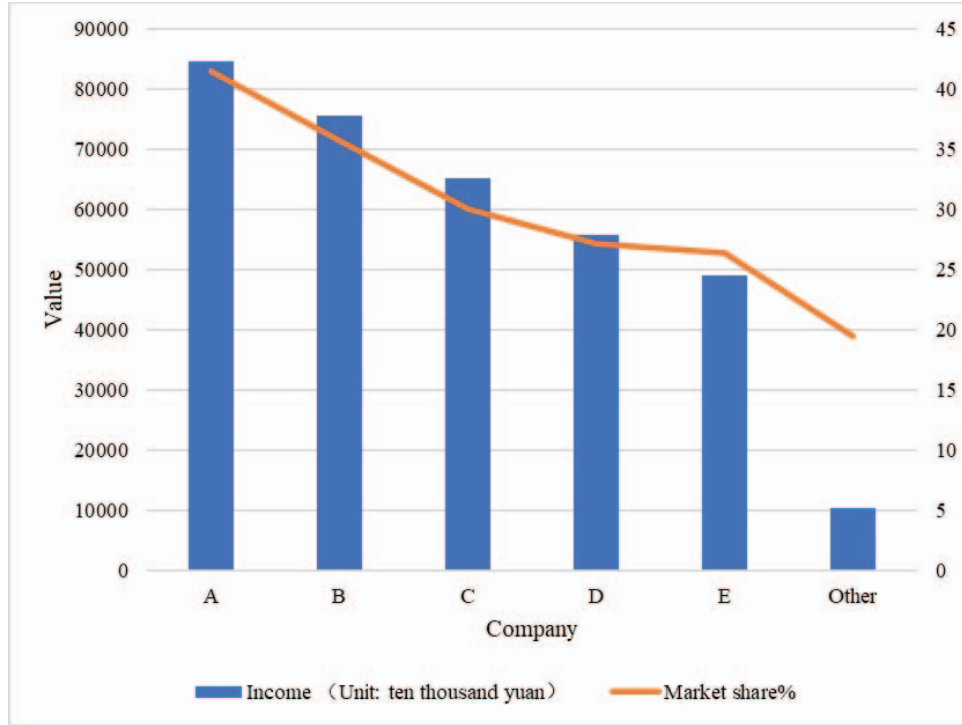


Fig. 1. Software and software supply chain income of electric power industry

At present, through the detailed analysis of the above related data, it can be seen that the marketing software system industry of Company A has the highest concentration at present, and the collective competition in this industry is in a very tense state. In order to enter the industry, we need to face the relevant technical threshold, the threshold of the company's brand, the threshold of daily business performance and the threshold of relevant investment capital.

B. Capacity and Characteristics of Software Target Market in Power Industry

Company M has organized and summarized the project information through various channels. The capacity of the software target market in the power industry is shown in Table II and Figure 2:

TABLE II. CAPACITY AND CHARACTERISTICS OF THE TARGET MARKET

Project category	Category 1 project	Category 2 projects	Category 3 projects
Number of items (individual)	17	32	57
Single average income (ten thousand yuan)	158	91	56
Single Total income (ten thousand yuan)	2347	3545	2421
Signing cycle (month)	14	7	2

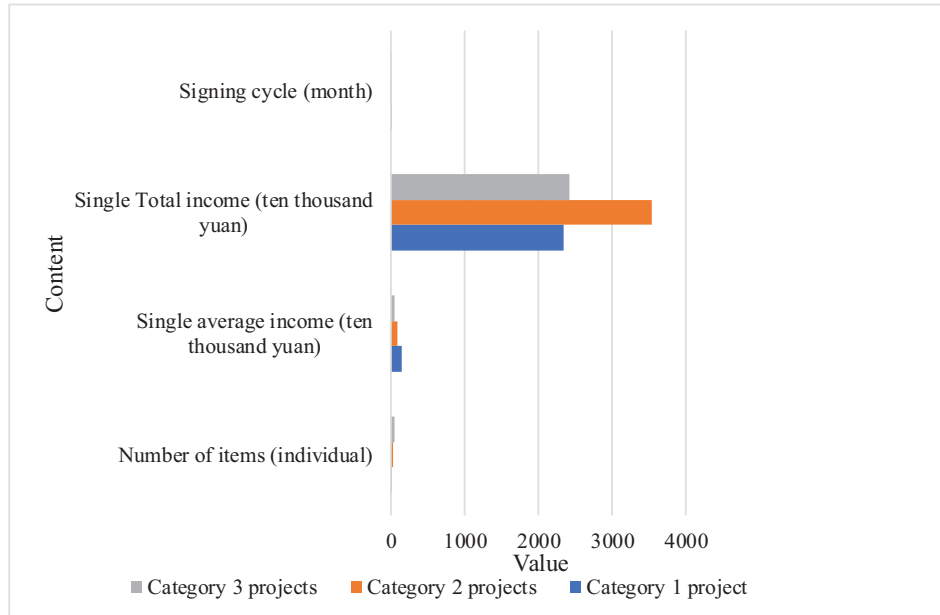


Fig. 2. Data chart of the software target market of the electric power industry

As shown in the above table, Category 1 projects account for the least proportion, while Category 2 projects account for the highest proportion. Category 1 projects have high unit price contract amount and high profits, but they are small in number and take a long time to sign. The single average income of the three types of projects is relatively small and the related profits are relatively small, but the time of the related sales orders is relatively short. Therefore, they have the characteristics of "less, stable and fast". In the same time period, many businesses can be accepted, and the final income is also very optimistic. Based on M Company, the most important value is to subdivide the market into two types of projects. Although the contract unit price of these types of projects is not as high as that of Class I projects, the signing cycle is acceptable, and it can be basically controlled to sign documents within the year. Then this part of revenue will contribute a lot to the operating revenue of this year. In addition, considering that this part of the project will not adopt the bidding method according to the practice, and with M's own scale, expertise in the market and customer recognition, this kind of project can be determined to win, so it is important to tackle sub projects. For Class 1 projects, although the contract unit price is high and the profit is high, generally larger projects will be purchased through bidding, which is complex and easy to lose orders. Therefore, for such projects, the sales personnel can only follow up on a long-term basis to make things better.

V. CONCLUSIONS

This paper studies the security strategy of power supply, which has important value and practical significance. It provides an idea and method for security strategy research of software supply chain security in power industry. Power supply security refers to maintaining the balance between power supply and demand, meet the normal needs of social and economic improvement. at present, there are few direct researches on power supply security and power shortage at

home and abroad, and lack of systematic discussion. This paper analyzes the current situation of China's power industry and the basic situation of power supply security, the new challenges faced by the current power supply chain security are put forward.

REFERENCES

- [1] Geosystems L. Adding intelligence to heavy construction. *International Water Power & Dam Construction*, 2019, 71(6):41-41.
- [2] Akulichev V O, Grabchak E P, Mishcheryakov S V, et al. Digital technologies for managing anthropogenic risks in electric power industry. *Safety and Reliability of Power Industry*, 2021, 13(4):248-256.
- [3] Maleki M G, Mohammadi R, Farrokhifar M. Accurate Coordination Method Based on Dynamic Model of Overcurrent Relay for Industrial Power Networks Taking Contribution of Induction Motors into Account. *IET Generation Transmission & Distribution*, 2020, 14(4):645-655.
- [4] Narine G. Prevention of Caribbean Electric Power Industry Accidents. *International Journal of Engineering and Technical Research*, 2020, 10(1):22-29.
- [5] Venegas J, Valenzuela A, Vicua C M. Correlation Between Power and Lifters Forces in Grinding Mills. *IEEE Transactions on Industry Applications*, 2019, 55(4):4417-4427.
- [6] Montaa D, Rodriguez D, Rey D, et al. Hardware and Software Integration as a Realist SCADA Environment to Test Protective Relaying Control. *IEEE Transactions on Industry Applications*, 2018, 54(2):1208-1217.
- [7] Magid S I, Zagredtinov I S, Mishcheryakov S V, et al. Standardization of digital technologies of simulator systems as a method of ensuring reliability of conditions of service of power engineering facilities (part 1). *Safety and Reliability of Power Industry*, 2019, 12(3):177-189.
- [8] Roos F, Bansal R C. Reactive power and harmonic compensation: A case study for the coal-mining industry. *Journal of Energy in Southern Africa*, 2019, 30(1):34-48.
- [9] Artale G, Cataliotti A, Cosentino V, et al. Real-Time Power Flow Monitoring and Control System for Microgrids Integration in Islanded Scenarios. *IEEE Transactions on Industry Applications*, 2019, 55(99):7186-7197.
- [10] Moghadasi A, Sargolzaei A, Anzalchi A, et al. A Model Predictive Power Control Approach for a Three-Phase Single-Stage Grid-Tied

- PV Module-Integrated Converter. IEEE Transactions on Industry Applications, 2018, 54(2):1823-1831.
- [11] Chanchina V E, Gaponenko S O, Kondratyev A E, et al. Application of mathematical modeling methods to determine the effect of soil on natural vibration frequencies of pipelines. Safety and Reliability of Power Industry, 2021, 14(2):142-147.
- [12] Sattarov R R, Garafutdinov R R. Research of the operation of a group of asynchronous motors at short-term voltage slopes for the conditions of the oil industry. Power Engineering Research Equipment Technology, 2021, 22(6):92-100.