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Exploration of on compliance strategy of TN PV certification service

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Resumo

A TN, como um dos principais organismos multinacionais de certificação a nível mundial, tem experimentado anos de rápido desenvolvimento no domínio da certificação fotovoltaica e, no contexto de uma concorrência cada vez mais feroz no mercado global da certificação fotovoltaica, a TN conseguiu obter uma posição de liderança no mercado em virtude da sua estratégia competitiva diferenciada.

Este documento identifica e argumenta as principais razões que levaram a TN a adotar uma estratégia competitiva diferenciada no domínio da certificação fotovoltaica e propõe medidas e planos específicos para a estratégia diferenciada. Este documento discute o conteúdo do planeamento estratégico competitivo a longo prazo para as empresas de certificação fotovoltaica é de grande importância, mas também para a indústria como um todo, o planeamento estratégico competitivo e a direção futura para trazer algum significado de referência.

Através de uma análise aprofundada da procura do mercado, inovação tecnológica, influência da marca e outros aspectos, podemos ver a importância e a aplicabilidade da estratégia competitiva diferenciada na indústria de certificação fotovoltaica. Para outras empresas de certificação fotovoltaica, aprender e aprender com a experiência bem sucedida da TN, combinada com a sua própria situação real para desenvolver e implementar uma estratégia competitiva diferenciada, será propício, em certa medida, para aumentar a competitividade das empresas. Além disso, toda a indústria de certificação fotovoltaica pode também inspirar-se no modelo de sucesso da TN para promover o desenvolvimento saudável e ordenado da indústria.

Palavras-chave: certificação fotovoltaica; estratégia competitiva; diferenciação; modelo das cinco forças de Porter;

Classificação JEL:

F120.4 Estratégias de desenvolvimento económico

F110 Política e planeamento

Abstract

TN has more than 150 locations in more than 70 countries around the world. During its 154 years of development, TN has continued to expand its services and improve its services in the fields of inspection, testing, certification and assessment. In the field of global photovoltaic certification, TN has completed more than 80GW of global photovoltaic products and photovoltaic system evaluation services by 2023. Since entering the Chinese market in 2009, the group has led the global PV product certification market with steady annual growth.

This paper firstly outlines the current status of the global PV market and certification field as well as the current status of competitive strategy research on the basis of a detailed compendium and review of relevant research literature at home and abroad. Then, it elaborates and analyzes the theoretical foundations that affect the competitive strategy of enterprises, and puts forward hypotheses to introduce the corresponding research tools and methods. Next, the characteristics of the PV certification market are analyzed through the Porter's Five Forces model; using the CPM matrix, TN's main competitors in the field of PV certification are identified, and the competitive behaviors of these competitors are analyzed. Next, a SWOT analysis of TN was conducted to thoroughly examine the group's competitive position in the PV certification market and the competitive strategies adopted. After an in-depth study, it is found that TN's leading position in the field of PV certification is mainly due to its differentiated competition, which successfully distances it from its rivals. It concludes with specific planning measures and some related recommendations.

Keywords: photovoltaic certification; competitive strategy; differentiation; Porter's five forces model;

JEL Classification:

F120.4 Economic development strategies

F110 Policy and Planning

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List of Abbreviations

IEC-International Electrotechnical Commission

UL-Underwriter Laboratories Inc.

WTO-World Trade Organization

ISO - International Organization for Standardization

TS-Technical Specifications

CSA- Canadian Standards Association

CQC-China Quality Certification Center

CPM- Competitive Profile Matrix

1. Introduction

The introduction chapter focuses on the background and significance of this dissertation research. It also unfolds to describe the research objectives of this thesis and summarizes the overall structure of the thesis.

1.1 Background of the study

With the rising demand for global climate change and energy transition, photovoltaic (PV) power generation, as a clean, sustainable and distributed form of energy, is receiving more and more attention and is widely used. To ensure the quality and safety of PV products, many countries and regions have implemented PV certification systems. However, since different countries and regions have different standards and requirements, such as International Electrotechnical Commission certification (IEC), Underwriter Laboratories certification (UL), The Bureau of Indian Standards (BIS) and so on. Therefore, it is one of the basic requirements to ensure the export of photovoltaic products to be certified according to the requirements of the relevant national and regional regulations.

In this context of increasingly competitive market, the quality and reputation of PV certification services will directly affect the competitiveness and reputation of enterprises in the market. Therefore, PV certification service organizations must develop appropriate competitive strategies to improve service quality and reputation, and enhance market competitiveness.

Currently, with the rapid growth of the global economy, certification has been used as a means to break through technical barriers to trade and the implementation of risk control in international trade has played a very important role. After years of development, product safety assessment has become a common use in international trade and has an important influence on an international rule, responsible for the issuance of the assessment of the certification company is as a buyer and seller outside the independent non-profit third-party organizations in international trade is playing an increasingly important role.

With China's accession to the World Trade Organization (WTO) and China's position as one of the world's most important exporting countries, more and more international certification bodies have entered China, making the competition in the domestic certification market enter a brand new stage. In various industries in China, the situation of monopolized competition between many European and American giant certification companies has been formed. Especially China's photovoltaic industry has been developing geometrically over the past decade. According to the China Photovoltaic Industry Association, China's production of PV modules has continued to grow from 76GW to 182GW, an increase of 1.4 times, and the global share of PV modules has been more than 70%. From 71.1% in 2017 to 82.3% in 2021, China's PV module production reached 288.7GW in 2022, up 58.8% year-on-year. It is expected that module production will exceed 433.1GW in 2023. In 2017-2018, the top three exporters of PV modules in China were India, Japan, and Australia. In 2022, China exported 86.6GW of PV modules to Europe, up 112% year-on-year, with the main countries including the Netherlands, Spain, Greece, Portugal, Poland, and Germany, all reaching over GW. In 2022, China exported 86.6GW of PV modules to Europe, an increase of 112% year-on-year, with major countries including the Netherlands, Spain, Greece, Portugal, Poland, and Germany, all of which have reached an export scale of more than GW, and the Netherlands, in particular, is the top exporter to China (Zhao, Q. S. & Wang, M. J., 2023). Export sales of PV modules have become an important part of China's export trade. The certification of PV products plays a very important role in exporting, and can even directly affect the sales of PV products.

TN has more than 150 branches in more than 70 countries around the world and has a history of 154 years up to now. Photovoltaic certification from the introduction of the Chinese market in 2009, but also one of the earliest batch of foreign-funded third-party testing and certification body organizations to enter the Chinese market, through the brand image, the construction of local laboratories in China and the business direction adjustment and other methods, the rapid layout of the business in

China, to accelerate the expansion of the third-party certification market share, and gradually in China's photovoltaic certification market to achieve a leading position. At the same time, with the process of global integration of trade, there are more foreign testing organizations entering the Chinese market, so how TN develops a reasonable and sustainable competitive strategy, as well as to continue to maintain the leading market position is crucial, which is also the reason for this thesis research.

1.2 Significance of the study

To carry out certification services in the Chinese market, all certification bodies must be strictly accredited and supervised by China's national accreditation bodies, a requirement that sets a high market access threshold. This system ensures the high quality and reliability of certification services and protects the interests of consumers. Currently, there are nearly 10 foreign-funded certification companies entering China, while the number of local certification bodies and certification agents in China exceeds 100. In such a competitive market, how to maintain a competitive advantage, retain customers, develop and implement an effective competitive strategy, as well as continue to lead the market position, has become an important topic that every certification body must think deeply and explore. In order to achieve these goals, certification bodies not only need to provide quality services, but also need to continue to innovate and adapt to market changes.

Compared with traditional industries, the certification industry has shown a strong monopoly, both globally and in the Chinese market. This monopoly is mainly reflected in several aspects: first, the market access threshold is high, making it difficult for new competitors to enter; second, the industry is dominated by a handful of large certification bodies with a large market share; and third, the demand for certification services is relatively stable, with low market fluctuations. Due to the special nature of the operation mode of each certification body, resulting in scholars' understanding of this special industry is relatively small, and there is a relative lack of research on the competitive strategy of the certification industry. The purpose of this paper is to conduct an in-depth investigation and research on the competitive

strategies of foreign-funded certification bodies and analyze their performance in different competitive environments in domestic and foreign markets. It is hoped that this study will provide a valuable reference for TN to organize and improve its own competitive strategy, as well as a useful reference for other PV certification service providers in the market competition.

1.3 objectives of the thesis

This paper is a study on the competitive strategy of TN PV certification services, analyzing the existing external and internal competitive environment of TN PV certification, analyzing the competitive environment and current situation of domestic and foreign PV certification service providers, and gaining a deeper understanding of the advantages and disadvantages of various competitive strategies; and at the same time, combining the strengths and weaknesses of TN PV certification to provide practical and feasible competitive strategies to meet the demand of China's PV certification market and stay ahead of the curve under the current fierce competition situation. At the same time, the strengths and weaknesses of TN PV certification are summarized to provide a practical competitive strategy for TN PV certification to meet the needs of China's certification market under the current fierce competition and stay ahead. By defining the objectives, this paper will focus on the following issues:

(1) What is the competitive environment and current situation of PV certification service organizations in the domestic and international markets?

(2) What are the aspects of the competitive strategy of a PV certification service provider?

(3) Which competitive strategy is appropriate for PV certification service organizations?

1.4 Structure of the paper

This study will be conducted in six chapters with clear dissertation objectives.

The first chapter is the introduction to the study, which provides the background to the main elements of the dissertation research, explains the significance of the study and the objectives of the study.

Chapter 2 is a literature review, reviewing and summarizing the current status and development trend of research in the photovoltaic industry, and synchronously reviewing the current status of research on competitive strategy to provide theoretical support and reference for subsequent research.

Chapter 3 is the theoretical foundation and methodology, which elaborates on the framework theory of competition and the methodology applied in the study of TN's competitive strategy in the field of PV testing and certification, and puts forward the hypothesis that the differentiated competitive strategy is the key to TN's differentiation in the competition.

Chapter 4 focuses on case study and comparative method to conduct analysis to find out the root cause of achieving competitive advantage; through Porter's Five Forces model analysis, the competitive situation of the PV certification industry; through the CPM matrix to determine TN's main competitors in the PV certification industry and for the main competitive behavior analysis; in-depth understanding of TN's PV certification of the competitive strategy and the implementation of the situation.

Chapter 5 presents the results derived from the methodology used, as well as the corresponding analysis and discussion of the competitive strategies presented in Chapter 4, using SWOT analysis to further derive the competitive strategies adopted by TN in the PV certification industry as well as the specific competitive strategy measures.

The final chapter, Chapter 6, summarizes the research findings and makes recommendations for competitive strategies.

2. Literature review

This chapter provides an in-depth investigation and analysis of the current situation and development trend of photovoltaic products and the photovoltaic industry, as well as a comprehensive study of the photovoltaic certification services market. Through these efforts, we were able to gain a comprehensive understanding of the overall status and development trend of the photovoltaic industry. In addition, we gained an understanding of the current research on competitive strategies, which provided solid theoretical support and reference for the subsequent research.

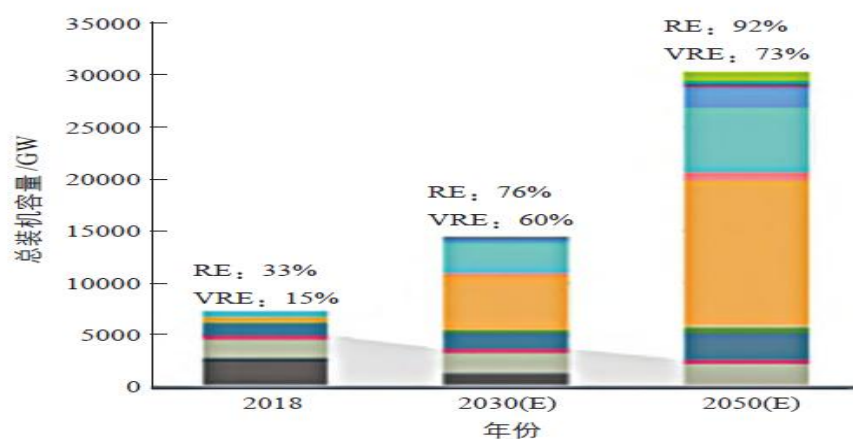
2.1 Photovoltaic Market Overview

This section analyzes and studies the Photovoltaic market with an aim to understand the Photovoltaic market trends as well as the total market volume changes.

2.1.1 Global Photovoltaic Market

In recent years, countries around the world have introduced PV industry support policies to promote the development of PV industry. As the cost of PV power generation decreases year by year, the market scale of PV industry continues to expand. the cumulative installed capacity of global PV power generation will be close to 5,221 GW in 2030, and more than 14,036 GW in 2050; the proportion of global PV power generation to total power generation will be about 19% in 2030, and about 29% in 2050. the global total power generation and installed capacity in 2030 and 2050 are predicted as shown in Figures 2.1 and 2.2. The global total power generation and total installed capacity in 2030 and 2050 are estimated as shown in Figures 2.1 and 2.2. In the figures: RE is renewable energy; VRE is variable renewable energy (IRENA, 2022).

Figure 2.1 - Global Total Installed Capacity



Source: IRENA, 2022.

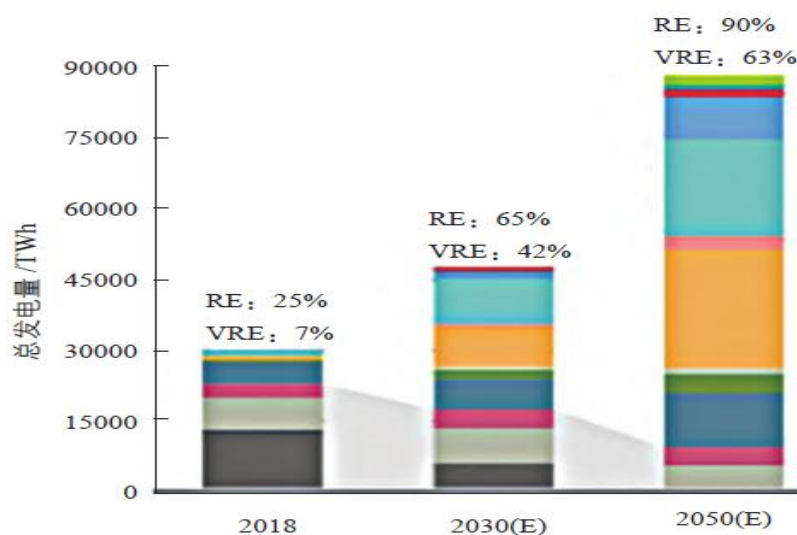
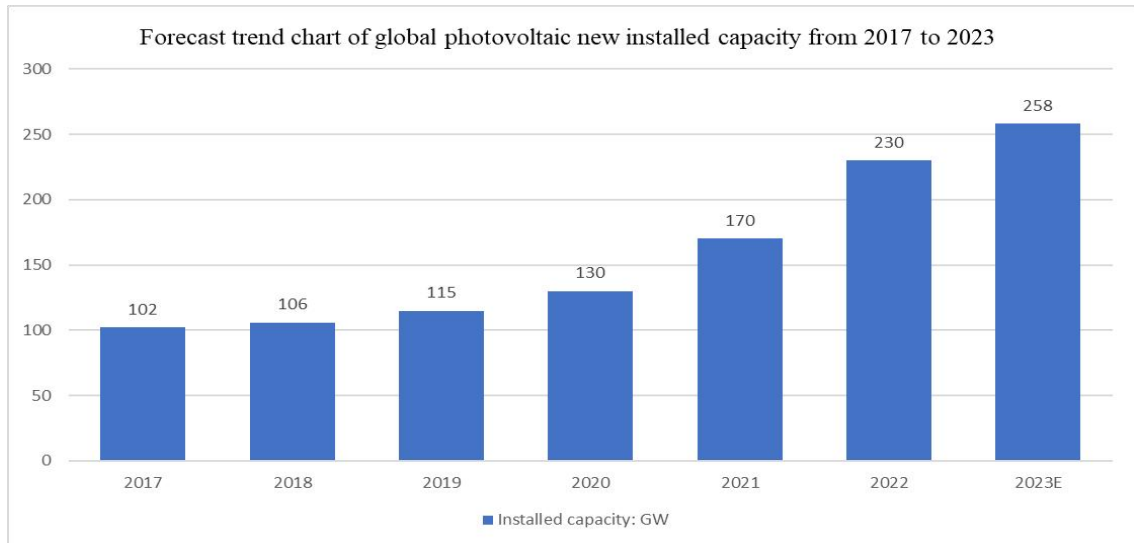


Figure 2.2 - Total Global Electricity Generation

Source: IRENA, 2022.

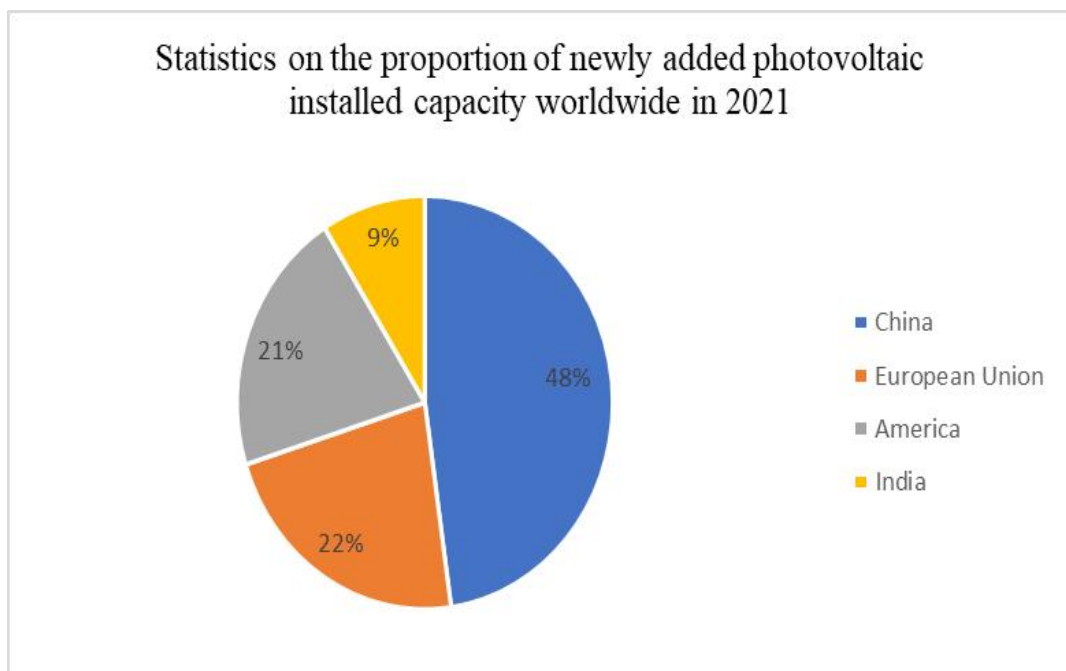
From the installed capacity target of 2030 and 2050, in accordance with the China Business Intelligence Network, the data show that the global new PV installed capacity in 2022 was 230GW, with a year-on-year growth rate of up to 35.30%, and the global cumulative PV installed capacity reached 1,156GW as of the end of 2022. it is expected that the global new PV installed capacity in 2023 will be 258GW. the graph shows the 2017-2023 global new installed PV capacity forecast.

Figure 2.3 - Global PV Capacity Additions Forecast Trend Chart



From the perspective of the global PV market, China, the European Union, the United States, India is the main PV application market. 2021, the global new PV installed capacity of about 170GW, China, the European Union, the United States, India, the new installed capacity of 54.9GW, 25.9GW, 23.6GW, 10.3GW, accounted for 32%, 15%, 14%, 6%, respectively.

Figure 2.4 - Global share of new PV installations



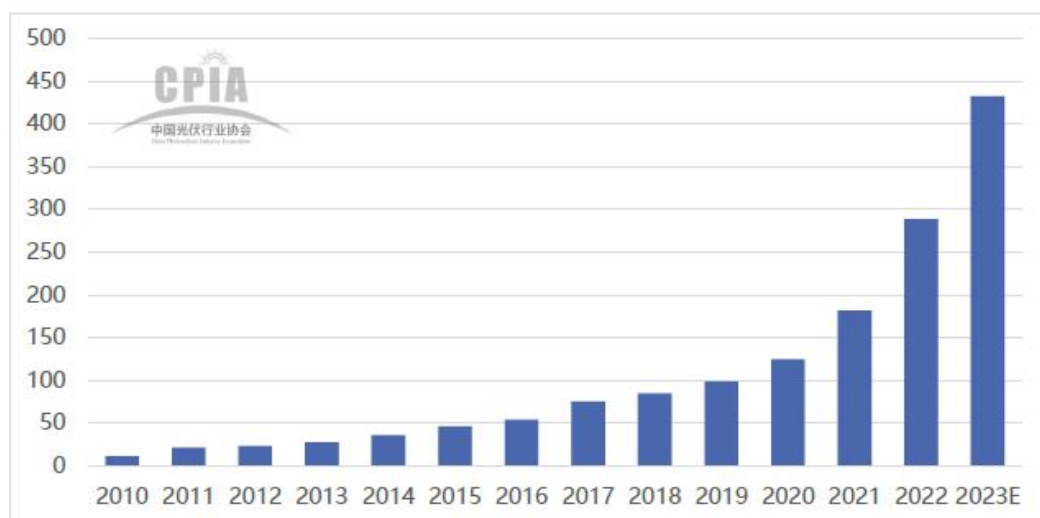
Source: Internet

2.1.2 China's photovoltaic market

Looking at the development of China's PV industry, Sun & Cao (2023) divided it into three phases: before 2011, it was in the stage of processing with supplied materials and "three heads outside"; from 2011 to 2020, the government subsidized vigorously, and PV production capacity was expanding rapidly; Since 2020, government subsidies have weakened, and the PV industry has entered a technology- and market-oriented phase of flat-price development. In the past 20 years, China's PV industry has been transforming and advancing amidst twists and turns, and the global market share of PV products has been increasing year by year, and the degree of foreign dependence has been decreasing year by year, so that it has built up a global competitive advantage, and has become a beautiful industrial name card of China's foreign trade.

In 2022, China's module output will reach 288.7GW, up 58.8% year-on-year, with crystalline silicon modules dominating. Among them, the top five companies accounted for 61.4% of the total output, and there were 11 module companies with output of more than 5GW. It is expected that module production will exceed 433.1GW in 2023 (China PV Industry Association, 2023).

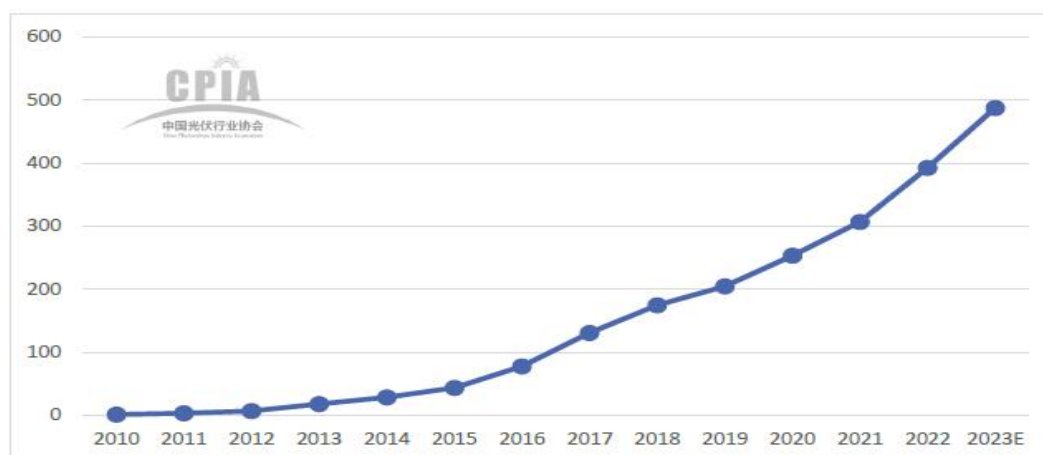
Figure 2.5 - National Solar Module Production 2010-2023 (Unit: GW)



Source: China Photovoltaic Industry Association. (2023).

As for the PV market, China's new grid-connected PV installed capacity will be 87.41GW in 2022, and the cumulative grid-connected PV installed capacity will reach 392.6GW, with both new and cumulative installed capacity ranking first in the world. The annual PV power generation capacity was 427.6 billion kWh, up 30.8% year-on-year, accounting for about 4.9% of China's total power generation capacity. It is expected that the newly installed PV capacity will exceed 95GW in 2023, and the cumulative installed capacity is expected to exceed 487.6GW (China Photovoltaic Industry Association, 2023); as shown in 2.6:

Figure 2.6 - Cumulative National Installed Solar PV Power Capacity, 2010-2022 (in GW)



Source: China Photovoltaic Industry Association. (2023).

The hot application end has driven the various links in the industry chain. Electronic Information Division (2023) shows that in 2022, the national output of polysilicon, silicon wafers, batteries and modules reached 827,000 tons, 357GW, 318GW and 288.7GW, respectively, and the total output value of the photovoltaic industry exceeded 1.4 trillion yuan.

In terms of product exports, China's PV product exports totaled more than \$51.2 billion in 2022, with a year-on-year growth of more than 80%. In terms of volume, PV modules exported about 153.6GW, wafers exported about 36.3GW, and cells

exported about 23.8GW, up 55.8%, 60.8%, and 130.7% year-on-year, respectively (Wang & Yu 2023).

2.2 Photovoltaic product certification services

This section concludes with an explanation of the concept of PV product certification services as well as the current status of PV certification around the world and the current status of the PV certification market in China.

2.2.1 Photovoltaic Product Certification Services

According to the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) clearly defined, certification is carried out by the accredited certification bodies in various countries, aimed at verifying that the products produced by an organization, the services provided and the implementation of the management system is in line with the relevant standards, technical specifications (TS) or its mandatory requirements of a formal conformity assessment activities.

The object of product quality certification is a specific product including services. (Cheng & Li, 2016) The basis of certification or the condition of being approved for certification is that the quality of the product (service) should meet the requirements of the specified standard and the quality system should meet the requirements of the specified quality assurance standard, and the way of proving that it is approved for certification is through the issuance of a product certification certificate and a certification mark. Its certification mark can be used on the products approved for certification.

As its literal meaning suggests, certification of photovoltaic products is the process by which nationally recognized certification bodies, such as the TUV (Technical Inspection Association), UL (Underwriter Laboratories Inc.), CQCC (China Quality Certification Center), etc., certify the compliance of photovoltaic products with the standards they have set. The certification of photovoltaic products is carried out by well-known organizations such as TUV (Technical Inspection

Association), UL (Underwriter Laboratories Inc.), CQCC (China Quality Certification Center), etc., which certify that the photovoltaic products comply with the relevant standards set by them. The certification of PV products can be divided into two important categories: safety certification and non-curvature certification (Gottschalg, 2020). UL, as the world's first independent third-party testing organization specializing in the research of PV product safety certification, took the lead in launching the safety standard UL 1703 for flat-plate photovoltaic modules as early as 1986, which was subsequently adopted as the U.S. national standard. UL 1703 was adopted as the national standard of the United States and has become the cornerstone of the highly developed field of PV module safety certification in the United States (Zhao, 2008).

2.2.2 Status of PV certification around the world

In terms of solar photovoltaic certification system, after years of accumulation, some foreign developed countries have formed a relatively perfect photovoltaic standards, norms and certification system. Internationally renowned PV certification mark is mainly TUV, UL, CSA, BIS and so on. Table 2.1 introduces and explains the main certification marks.

Table 2.1 - Introduction to Global Certification Marks

Authentic ation	zone of applicatio n	Authentic ation	zone of application	Authentic ation	zone of application
CB	Glob al	CQC	China	CEC	Califo rnia, USA
TUV	Germ any and	CGC	China	MCS	Britain

	Europe				
CE	Euro pean Union	AS CEC	AusT Calia	INMETC O	Brazil
UL	Amer ica	MET	Ameri ca	PSI and COC	Pakist an
CSA	Cana da	SNI	Indone sia	JET	Japan
BIS	India	CSA	Ameri ca	NRE	Korea

Source: Self-elaborated

2.2.3 Status of PV Product Certification in China

In today's Chinese PV industry, there are two main certification marks that are widely used: the "CQC" and CGC certification marks. These marks signify that a product complies with the relevant standards and regulations set by the Chinese government, and are important references for consumers when choosing PV products.

In China, there are only two local certification bodies that are qualified to issue the China Certification Mark, which are Beijing Jianheng Certification Center and China Quality Certification Center (CQC). These two organizations have high authority and credibility in the field of PV industry certification, and their certification marks are widely recognized.

In the field of solar energy, Check & Balance is one of the first third-party organizations in China engaged in the certification and testing of solar photovoltaic products. It is a certification body (RECB) and inspection body (REIB) accredited by the International Electrotechnical Commission's Renewable Energy Certification

System (IECRE), and a certification body (NCB) and inspection body (CBTL) accredited by the International Electrotechnical Commission's Electrotechnical Product Certification System (IECEE).).

China Quality Certification Center (CQC) is a certification body set up by the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) with the approval of the Central Committee for Institutional Preparation. After the reorganization in 2007, it is now under the China Certification & Inspection Group. China Quality Certification Center to carry out certification of photovoltaic products late, but because it is a government agency, it is estimated that there will be a great deal of growth in the future space advantage.

2.3 Current status of research on competitive strategy

2.3.1 Historical process of business strategy research

American scholar H. Igor Ansoff (1960) introduced "A Theory of Corporate Strategy" for the first time to put forward the basic meaning and concept of corporate strategy; Chen & Pan (2003) mentioned in 1965 Kenneth R. Andrews in the United States, made it clear that the organizational groups need to use their own resources in order to establish the corresponding organizational strategy; Zhang MY & Zhang WS (2005) mentioned in the 1970s and 1990s Professor Henry Mintzberg of Canada put forward the 5P concept of corporate strategy, i.e. plan, planner, model, positioning, concept. Zhang MY & Zhang WS (2005) mentioned that in the 1970s and 1990s, Prof. Henry Mintzberg of Canada put forward the concept of the 5Ps of corporate strategy, i.e. plan, planner, model, position, concept, the core of which is to illustrate that strategy is essentially a developmental process. Ni & Wu (2001), in their article on the evolution of strategic management thinking in the United States, mentioned that in the 1980s and 1990s, the United States of America had a strong strategic management culture, which was based on the idea of "strategic management". In the 1980s and 1990s, Mr. Hamel of the United States, put forward the strategy in nature is a kind of imagery and revolution, the strategy can be divided into three types of companies: rule makers, rule takers, rule breakers, etc. Porter (1997) put forward the strategy is in

fact a kind of choice terms, the strategy contains positioning, trade-offs, matching, and so on. Zhou & Zou (2003) divided strategy into planning strategy, centralization strategy, and differentiation strategy according to the market and the enterprise itself, which makes strategy further subdivided. Zhou (2010) clearly pointed out that the radius of vision determines different strategic choices, and different strategic choices will produce different results. Ru & lin (2016) suggest that companies can consider adopting differentiation strategies to ensure that they stay ahead of the competition and thus realize the overall sustainable development of the company. Xu & Xie (2016) discuss in detail the research direction of strategic management in China in the 21st century. Wang & Hong (2019) combine the current market, political, economic and social conditions at home and abroad with the current market, political and economic conditions at home and abroad. current domestic and foreign in the market, political and economic situation, analyzed the marketing status quo of modern enterprises, and provided a reference direction for enterprises to choose what kind of strategic management. Qin Yingxuan (2021) explores and analyzes the different changes in the strategic management of enterprises in the context of "Internet 10" and the reasons for the different changes.

2.3.2 Analysis of the Current Status of Research on Enterprise Competitive Strategies

Although it has been 43 years since 1980, scholars around the world have not stopped their research on corporate strategy and management, and Professor Porter (1997) proposed the Five Forces Model, which is a theory of the Five Forces Model built and formed through different practices and theories after an in-depth study of the three basic strategic dimensions, which has made a very significant contribution to the development of corporate strategic management and its theories. This research has made a very significant contribution to the development of corporate strategic management and its theory.

Michael creatively put forward the five forces of competition model, but also put forward the cost leadership, differentiation, concentration of three strategies. Porter

clarified the concept of competitive advantage and its meaning, affirmed the role and significance of competitive advantage, and its value chain as the basis for the formation of the strategic analysis model of the core competence school. Prahalad & Hamel (1990) core competence is the most core and fundamental part of all the competencies. Prahalad & Hamel (1990) core competence is the most core and fundamental part of all the competence, modern market competition in the essence of the competition between the core competence of the market, Wernerfelt (1995) laid the foundation for the formation of the strategic resources school, put forward the core competitive strategy of the enterprise is an important source of enterprise competitive advantage.

Domestic scholars from various industries also conduct in-depth research from different aspects of competitive strategy, such as domestic well-known experts and scholars to interpret the strategy operator (2007) Ai Feng, director of the China Development Research Institute of the Central Plains (2002), puts forward the strategy to continuously strengthen the competitive advantage; Ge (2007) based on the constraints of the optimization modeling to build a new framework for the study of competitive strategy research methodology to conduct an in-depth reflection on the competitive strategy, put forward to the competitive strategy of the various research methods; Zhang (2021) published "Research on Competitive Strategy of Gree Electric Appliances", which analyzed the competitive strategy of Gree Electric Appliances in detail. All these ideas provide a solid foundation for this study to analyze TN's competitive strategy.

2.3.3 Strategic management-related research

Strategic management theory has been systematically used to guide enterprise practice since the 1960s, and has been the development of a long theoretical research time is not long, the classical strategy theory, competitive strategy theory and resource-based management theory is the development process of the three important phases, these classic theories provide us with a systematic way of thinking. In the early 1960s, Chandler, a management scientist, first proposed the study of corporate strategy in his

book *Strategy and Structure: Some Chapters in the Growth of U.S. Business Enterprises* and put forward the argument that "structure follows strategy", which clarifies the environment, strategy and Organization. The interrelationship between environment, strategy and organization is clarified. He argues that business strategy meets the market needs by adapting to the environment, and organizational structure follows the strategic direction of the firm to maintain its effectiveness (Alfred D, 2002). The research on the issue of strategy construction has led to the formation of two schools of thought, the "design school" and the "planning school", which are similar to each other. The design school believes that in the formulation of strategy, top management should take the role of strategy designer and supervise the implementation of strategy, fully analyze the opportunities and threats of the external environment, and conduct in-depth analysis of the internal strengths and weaknesses of the enterprise, and excellent strategy is characterized by creativity and flexibility, and the strategy construction mode focuses on the guiding principles and is simple and informal (Mintzberg *et al.*, 2018). The dominant idea of strategic management in the 1980s was the theory of competitive strategy represented by Porter. According to him, gaining competitive advantage is the core idea of strategy, and the attractiveness of a firm's industry and its relative competitive position in the industry determine its competitive advantage. Select the industry with the greatest profit potential is the first task of strategic management, followed by determining its position in the industry, Porter in the competitive strategy summarizes the five competitiveness of the industry to drive competition, that is, the "five forces model", the intensity of competition and profitability of the industry by the five competitiveness of the combined power to determine, while providing three general strategies to deal with the five major competencies, which are: total cost leadership strategy, differentiation strategy, and concentration strategy (Porter, 2014). "Core competencies" are not a measure of a company's value of itself, but rather the value of that company in the eyes of its customers. Companies must create value and exchange value with consumers. The greater the extent to which firms and consumers work together to expand their networks and build consumer communities, the more they can provide consumers

with unique and personalized experiences, and the greater the elements of core competence they can create. Pfeffer & Salancik (1978) put forward the theory of resource dependence, which suggests that organizations can't produce resources, but must rely on their environment to survive, and that adjusting the degree of dependence on the environment is one of the means to do so. Pfeffer & Salancik (1978) proposed resource dependence theory.

2.4 Summary

The above first investigates and analyzes the photovoltaic products, global market, and certification services market to understand the overall status and development trend of the photovoltaic certification market; second, it analyzes the current status of the competitive strategy research and lays the foundation for the research theories presented below.

3. Rationale and methodology

In this chapter, the competitive strategy framework theories cited in the study of TN's competitive strategy in the field of PV testing and certification will be elaborated, and summarized to form a theoretical foundation that guides the implementation of this study and the selection of the final competitive strategy.

3.1 Definition of relevant concepts and theoretical basis of the study

This section introduces the concept of competitive strategy, presents the theoretical foundations of the study, and describes three competitive strategy ideas.

3.1.1 Strategic theory

The concept of "strategy" won recognition in management circles after 1965. The famous management scientists Andrews and Ansoff described the term strategy in their management works. Since then, the term "strategy" has been applied to business development, and business strategy has come to have different meanings depending on how it is applied to different aspects of business (Mintzberg et al., 2020).

"Strategy" can be interpreted as the development direction of an enterprise in the process of development based on its own development characteristics after analyzing the internal or external environment in which it operates. "Strategy" is the behavioral orientation of the enterprise to develop various types of decision-making rules; "strategy" lies at the core of the enterprise's own unique competitive advantage, the enterprise only in the industry to obtain a good competitive advantage, in order to achieve its own good and fast development (Ma, 2019).

Strategies can be categorized as corporate, operational, and functional, depending on the role they play at their own levels (Hu, 2002).

Figure 3.1 - Composition of the corporate strategy system



Source: Hu (2002).

3.1.2 Overview of competitive strategies

One of the most popular and well-researched books is *Competitive Strategy*, written by Professor Porter (1997), a tenured professor at the Harvard School of Business Administration. In the continuous struggle against various competitive environments, Professor Porter proposed three types of competitive strategies after a deep analysis of the enterprise value chain, namely: total cost leadership strategy, differentiation strategy, and the search for niche specialization strategy. The three strategies are analyzed below:

1) Total Cost Leadership Strategy. After analyzing the value chain thoroughly, the strategy of total cost leadership is to improve the operation to be extremely efficient and to generate economies of scale. As the experience model matures, it is improved and optimized to iterate the original model and upgrade efficiency, thus controlling raw materials, labor, and general management costs, which are the major cost components. Enterprise managers need to thoroughly analyze their own cost composition, targeted to control costs, such as reducing some of the high cost of research and development and reduce the marketing budget. Managers should be actively involved in cost control and pay attention to it, so as to achieve the goal of

total cost leadership. Of course, cost reduction does not advocate sacrificing service levels and product quality, but it is necessary to selectively reduce costs at these levels.

After adopting a cost-competitive strategy, an enterprise can gain good profits in the short term by producing a large number of products or providing corresponding services at the lowest possible cost, which helps the enterprise to give full play to its own competitive advantages. However, at the same time, the industry will attract a large number of similar entities to produce or provide similar products or services, and the threshold of entry into the industry will be lowered, which will lead to an oversupply of the products or services produced by the firms (Liu & Chen, 2004).

(2) Differentiation strategy. The so-called differentiation strategy refers to the enterprise to provide their own products or services for a thorough analysis, taking into account some of the competitors' homogenization of the competitive situation, to the existing services or products to take the initiative to differentiate. In today's corporate competition, the implementation of differentiation strategy can have a lot of whimsical ideas can also be invisible to others in the link to innovate, so as to achieve differentiated development strategy. Such as technology to take a different approach to invest in professional research and development, product performance to cover the competitors ignored the point, or service to change the traditional model so that users in other competitors can not feel the unique service experience, or in the design of the product using a bold and innovative avant-garde design to achieve the differentiation of the development strategy. At the same time, it is often most reasonable for a company not to be limited to one aspect of differentiation, but to have its differentiation characteristics in several aspects to cope with the constantly updated competitive environment.

However, with the progress of society, people began to pay attention to the quality of life, the pursuit of product personalization and customization, and products, especially consumer goods, the rapid replacement of products, which requires enterprises need to improve their own innovation capabilities, so that the products or

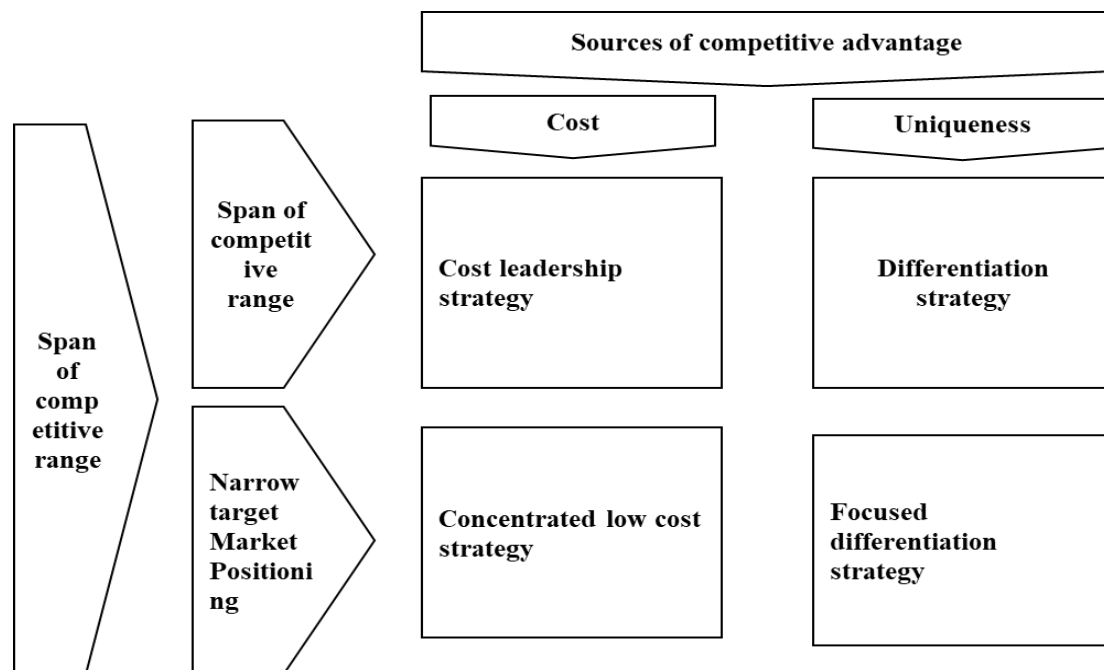
services produced by the characteristics of the unique attraction, which requires enterprises to increase the investment of funds, time and effort, then enterprises in the operation of the process of exceeding the cost of calculating the cost of its production or provision of services (Yao, 2021). Then the excess cost of the enterprise in the process of operation is counted as the cost of its production or service provided (Yao, 2021). Consumers tend to look at the price when they consume, even if the product or service has its own characteristics and attractiveness different from other similar products, consumers will be careful to consider.

(3) The strategy of searching for specialization in niche areas. The key point of the implementation of the development strategy of the search for niche specialization is to require business managers to understand their own business model, after fully analyzing the business information, have a unique vision to find the selling point of the niche, which can be the specific needs of the customer base can also be the product's goals and positioning aimed at a specific purpose. However, the requirements of the specialization strategy are more stringent than the above two strategies, requiring that the needs of specific consumer groups in the market segment are significantly different, followed by the need to have a good market environment, and ensuring that there are no similar firms in the market producing the same products or providing the same services (Wang & Zhang, 2010).

Figure 3.1 illustrates a comparison of the three competitive strategy ideas described in the previous section. We can see that the source of advantage of the total cost leadership strategy is cost, and the source of competitive advantage of the differentiation strategy is its uniqueness, but both the total cost leadership and differentiation strategies are designed to focus on a wider target positioning in the whole industry chain. However, the centralized development strategy is mainly located in a certain field of analysis of the market, its target market positioning is narrower, but precisely because of the narrow, the enterprise can better concentrate resources and capabilities to serve the consumers in this segment. Enterprises in the

application of specialized development strategy should always be clear and around this gap market to perform, so its disadvantage is also can not do a great scale and high performance returns. Therefore, with the later development, also gradually derived the total cost leadership and specialized development, and differentiated development plus specialized development of parallel two strategies of the implementation of the program. Professor Porter has cost advantage or differentiation advantage of enterprises will also note the strategy, in the face of similar or different enterprises competition, how to maintain their own characteristics for enterprises is very important.

Figure 3.2 - Schematic diagram of a firm's competitive strategy choices



Source: Porter (1997)

3.1.3 Competitive Advantage Theory

The concept of "competitive advantage" was introduced in 1939 by the British economist Chamberlin (1938) in Theory of monopolistic competition, and by Evered, R. (1980) in New perspectives on business policy and planning in strategic management than it was Hofer and Schendel who introduced it into the field of strategic management. Perspectives on Business Policy and Planning than pointed out that it was Hofer and Schendel who introduced it into the field of strategic

management. Over the past few decades, many researchers at home and abroad have made efforts in this direction, and the theory has been greatly developed and perfected, from the beginning of the acquisition of transient competitive advantage to the depth of the root of the acquisition of sustained competitive advantage.

Competition is at the heart of business success or failure, and the determinants of competitive position within an industry are the basis for making competitive strategic choices. Competitive advantage stems primarily from a firm's ability to create cost value for the buyer. The buyer's advantage lies in the firm's ability to satisfy the same benefits to its customers at a lower price than its competitors or to provide customers with special benefits for which they are willing to pay an additional markup. Barney (1991) suggests two basic types of competitive advantage: cost leadership and differentiation; Michael Porter suggested in the early 1980s that for the corporate strategy formulation, which has had a global and far-reaching impact. Used in the analysis of competitive strategy, it can be used to effectively analyze the customer's competitive environment. The rules of competition embody five competencies, i.e., the five forces model proposed by Prof. Porter, and the combined force of these five competencies determines the average return on investment achieved by a company in a given industry excluding the cost of capital.

Management guru Drucker (1994). Once said, "For business, the future is critical." Obtaining a sustainable competitive advantage is a prerequisite for obtaining profits above the industry level in the long run, and firms obtaining a competitive advantage should have low-cost or differentiation conditions, originating from the structure of the industry, and the cost leadership strategy, differentiation strategy and concentration strategy are the basic strategies above the average level of the industry's performance, which involve different paths to achieve a competitive advantage, and also how to realize different of competitive advantage.

3.2 Theoretical analysis and hypothesis formulation

This section focuses on analyzing the differentiated competitive strategy based on the

above, combining the characteristics of the PV certification industry and proposing the hypothesis that TN adopts a differentiated strategy.

1) Strategic differences and the impact of competitive advantage on business operations

Enterprise strategy guides the future development direction of the enterprise, and strategic positioning and financial decision-making are closely linked in the operation of the enterprise. Each industry in its development process gradually formed a set of legal requirements and industry development characteristics, and can effectively resist the industry's risk of conventional strategy model. With the increasingly fierce competition in the market, many enterprises are not satisfied with the conventional strategies in the industry and start to pursue strategic differences in the hope of cultivating unique competitive advantages.

The "differentiation strategy" is to differentiate the products or services offered by a company to have a certain uniqueness in the market. When the number of similar enterprises increased, the products produced or provided by the business tends to homogenize and reduce the competitiveness of enterprises in the same industry, consumers in the face of the same products or services, it will reduce the sensitivity of its consumption, if the enterprise has implemented the differentiation strategy, the products it produces or services provided by differentiating itself from similar products, so that its products or services have a personalized and distinctive, and then It has a good competitive advantage. However, with the progress of society, people began to pay attention to the quality of life, the pursuit of product personalization and customization, and products, especially consumer goods, the rapid replacement of products, which requires enterprises need to improve their own innovation capabilities, so that the products or services produced by the characteristics and different attractions, which requires enterprises to increase the investment of funds, time and energy, so the enterprise in the operation of the process of exceeding the cost of calculating the cost of the products or services provided (Yao), which is the most important factor to improve the quality of life of enterprises. or services provided

(Yao, 2021).

The Gaze Volt certification industry is characterized by the following (Wan, 2012).

Market Competition: The industry is highly competitive, market share is increasing though, and many companies are competing for market share. In order to stand out from the competition, companies need to have their own characteristics and advantages to enhance brand awareness and customer trust through differentiation strategies.

Customer demand: As the share of PV products exported overseas increases and the countries exported cover a wide range, the demand for PV certification products is becoming more and more diversified. PV certification companies can meet the different needs of customers through differentiation strategies to enhance customer experience and satisfaction.

Technological innovation: PV module technology is constantly evolving, and enterprises must constantly innovate in their technological capabilities in order to keep up with market changes. The differentiation strategy can encourage enterprises to increase investment in technology R&D and improve technology level and product innovation ability.

In a competitive market, obtaining a sustainable competitive advantage is a prerequisite for obtaining profits above the industry level in the long run, and firms obtaining a competitive advantage are required to have low-cost or differentiation conditions. For example, capitalizing on first-mover advantage and maintaining technological leadership (Zhang, 2005).

Therefore, based on the above analysis, the hypothesis is formulated that TN can differentiate itself from the competition by adopting a differentiation strategy.

3.3 Strategic research methods and tools

This section mainly proposes Porter's Five Forces Model, Competitive Profile Matrix

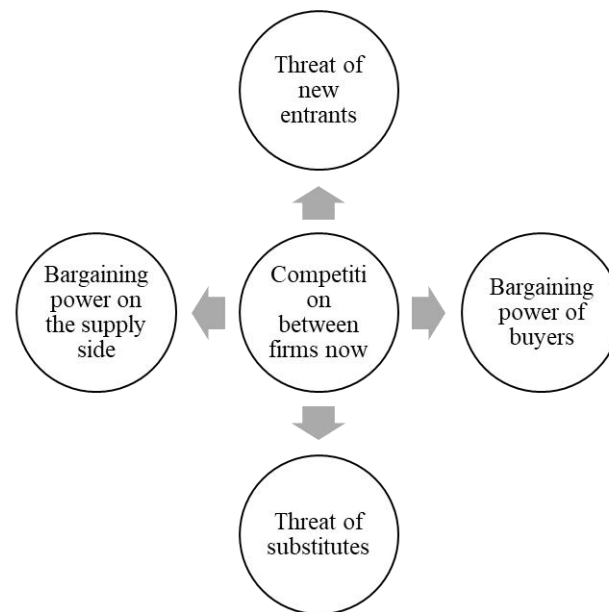
i.e. CPM (Competitive Profile MaTCix) Analysis Matrix and SWOT Analysis as the main research methods and tools to analyze the competitive strategies adopted by TN.

3.3.1 Porter's Five Forces Analysis Model

Professor Porter in the study of the enterprise's competitive strategy selection and formulation process found that enterprises in the selection of appropriate strategies should be a thorough analysis of their own value chain, and then can be based on their own strengths and weaknesses to build on their own strengths and weaknesses to choose their own competitive strategy, there is no best strategy, only more suitable for the enterprise's own development needs of the competitive strategy. Professor Porter summarized five kinds of core competitiveness, they are: the existing competition between rivals in the industry, from the market may be the threat of new entrants, whether there is a substitute goods or services, the bargaining power of the enterprise's suppliers, and the enterprise's production of products or services for the consumer's ability to price. This is the famous "Porter's Five Forces Model". Professor Michael Porter put forward the theory of enterprise competition "five forces model", the majority of entrepreneurs as well as scholars on the study of enterprise competition strategy put forward the core model of the guiding value and thus produce a far-reaching guiding effect. The five elements determine the competitiveness of an enterprise in the market and the profitability of the enterprise, and the influence of the five elements on the long-term planning of an enterprise will be discussed in the subsequent chapters of this thesis (Wu *et al.*, 2021).

The role of enterprise products or services in the market competition, enterprises can analyze the five elements to explore the potential competitors and the enterprise's own competitive weaknesses, the five forces model to the enterprise to develop long-term planning has brought new ideas and direction. Figure 3.3 below shows: Porter's Five Forces Model.

Figure 3.3 - Porter's Five Forces model diagram



Source: Self-elaborated

Enterprises today in the constantly updated market demand and consumer tastes change in the survival and growth of their own, bigger and stronger. However, in the complex and fast-changing business competition environment, in the face of a wide range of various competitive elements involved, enterprises should choose the appropriate method to analyze and study, Professor Porter's five forces analysis theory undoubtedly provides a better analysis method for this enterprise. This interrelated and influential species of competitive elements will have an impact on the development of enterprises or the formulation of strategy. So what are these five forces, how to understand, the specific development is described as follows:

(1) The threat of industry competitors: Once a company is founded, no matter what kind of situation it is in, even if it is in a monopolized industry, it will also face competitors, only the relationship between the enterprise and the competition sooner or later. Because the market is constantly changing, while consumer tastes and needs are also changing, if the enterprise only enjoys the immediate leading edge or high profits, then competitors will definitely focus on the shortcomings of the enterprise, to

develop a corresponding competitive strategy to counterbalance the competitors, so as to seek their own growth.

(2) The bargaining power of the buyer: once the enterprise's products are launched, there must be consumers to pay for them. Purchasers because of their own strong demand or from the high competitiveness of the enterprise's product innovation or quality service deeply to attract buyers, need to pay attention to the bargaining power of the buyer. Companies can sell quality products at low prices to attract consumers. Can also clearly know the needs of consumers, to overwhelm the development of high-priced sales strategy, the development of the strategy here is closely related to the bargaining power of the buyer.

(3) Bargaining power of suppliers: In the modern industrialized era, supply chain management is a very broad field. Enterprises themselves out of cost or insufficient production capacity and many other considerations. Therefore, enterprises should consider the bargaining power of suppliers when dealing with competition and positioning their own products or services, so as to avoid the unfavorable impact of the cost brought by insufficient supply, and make themselves lose the competitive advantage.

(4) The threat of potential competitors: Sometimes companies get caught up in the current state of good operations or focus only on competitors who have already established themselves in the industry. However, in today's fast-changing technology, once the new technology, the competitive situation may change. Therefore, it is important for companies to study and identify potential competitors to avoid the original high-margin products or services from becoming unsustainably profitable due to competitors' strategic adjustments. Companies in each industry are not fixed and unchanging; there are new entrants, as well as those who have maintained their presence for many years, and those who have withdrawn. Especially when firms in a particular industry enjoy a period of high product margins after selecting the right competitive development strategy upfront, other firms will continue to focus on what suits them and they will attract other firms in the industry to join them, which may

have other cost or supply-chain advantages because the new entrants are likely to come in with large amounts of financing, targeting firms' traditional Strengths, while forcing the industry some small and medium-sized not yet the survival of these enterprises profit margins, they face potential competitors rivals may also choose to transform to join other industries, which leads to further intensification of competition in the industry.

(5) Threat of substitutes: The threat of substitutes usually refers to the fact that the product launched by the enterprise only satisfies some basic functions, and there were already similar products on the market. This product and substitutes belong to different types of products, but also have similar or alternative product characteristics, and accordingly can also refer to alternative types of services. Substitutes will produce a great threat to the current product or service or at a particular time to directly replace the product, for example, such as mineral water and milk, if in the human character of thirst, consumers will not insist that must go to the milk, "quench their thirst" will be their main demand characteristics. Then milk should go to promote it in addition to quench the thirst of other additional features, such as taste, packaging, etc. to avoid its homogenization of thirst-quenching drinks this position. Enterprises in the design of a new product or the launch of a new service, the first thing to look at the market positioning of similar products and sales conditions, do not promote direct competition. But also more to consider the threat of substitutes, to avoid enterprises in making new products. R & D huge investment, because there is no exclusivity factors to consider, into other new market alternatives under the stone.

3.3.2 Questionnaires

In the data collection stage, the questionnaire was mainly used to collect first-hand data by distributing it to the target respondents; the questionnaire design was based on the existing theoretical models and referred to the relevant literature to ensure that the questionnaire was reasonable and scientific. The questionnaire is distributed through on-site visits. The target respondents are companies that have consulted PV certification services and have completed PV certification. A total of 200

questionnaires were distributed, and 165 valid questionnaires were collected, with a recovery rate of 80%.

In order to ensure the accuracy and reliability of the data, the collected questionnaires will be entered and coded in this study to exclude outliers and invalid values, and finally the data file will be formed and analyzed for centralized trend analysis through SPSS software to get explorable conclusions.

Limitations will also be taken into account in this study, as the questionnaire survey has a relatively homogenous research population and the results of the study have some limitations. The process of this research will maintain a certain degree of notarization and strict sample selection to guarantee the rigor of the research.

In conclusion, this study will provide an in-depth analysis of TN and its key competitors through a careful research design and exhaustive data analysis to reveal its competitive advantages in the field of PV certification.

3.3.3 Competitive Posture Matrix

The Competitive Profile Matrix, or CPM (Competitive Profile MaTCix) analysis matrix, is an assisting tool in the analysis of the internal and external environments, and this analytical model is primarily applicable to identifying the strategic position of a company's major competitors relative to the company, as well as analyzing the competitive advantages, as well as the competitive deficiencies, that are unique to the company's major competitors. According to the nature of the industry to determine a number of key elements of competition between companies, and the importance of these elements in the company's operations listed weights, while screening out the main competition with the assessment object similar to the main competition object, one by one according to the key elements of the competition object scoring, each element scores and weights multiplied by the total sum, to get the summed up total score of the company, and based on the size of the score to determine the company's overall competitiveness level (Tang, 2020).

This thesis matrix weight assignment model is as follows, select market share, service level, price, time, brand, technical capability key factors, weight assignment,

scoring, calculation of weighted scores, calculation of total weighted scores, so as to obtain the total weighted score of the company, the minimum score is 1.0 points, the maximum score is 5.0 points, and the average total weighted score is 3 points, if more than 3 points, then it will be established as a TN company's in the photovoltaic product certification. If it exceeds 3, it is established as TN's main competitor in the PV product certification business.

3.3.4 SWOT analysis

In the process of using SWOT, companies explore their own strengths and weaknesses, analyze internal factors and external factors, and objectively explore the future development direction of the company (Wang MY & Wang CC, 2020). By analyzing the company's existing resources, the company's internal advantages and disadvantages as well as the opportunities and threats of the external environment are judged, so as to choose a suitable strategy for the company's development. S is internal advantages, W is internal disadvantages, O is opportunities of the external environment, and T is threats of the external environment. S is internal advantages and disadvantages, W is internal disadvantages, O is external environment opportunities, and T is external environment threats. Internal advantages and disadvantages are mainly analyzed by comparing the company's own strengths and competitors, while external opportunities and threats are mainly analyzed by the changes in the external environment and the influence on the company itself. By using SWOT analysis, TN's strengths and weaknesses as well as opportunities and threats are analyzed to match a suitable strategy for the company.

3.4 Summary of the chapter

This chapter explains the relevant competition theories and analyzes the theory of differentiated competition, proposes that differentiated competition strategy is the key for TN to stand out from the competition, and introduces the strategy research methods and tools: Porter's Five Forces Model, Competitive Posture Matrix, and SWOT Analysis, laying the foundation for the following analysis.

4. Introduction of TN's PV certification business and analysis of the competitive market environment

4.1 Introduction and current status of TN's PV certification business

The TN Group of Companies is one of the three certification bodies authorized by the German Association for Technical Supervision. It has more than 150 branches in more than 70 countries. As a leading global technical service provider in the field of solar energy, TN Group is committed to providing manufacturers, installers, service providers and investors with a full range of testing and certification services throughout the entire product supply chain, from solar PV modules and components to PV power systems. Our PV product testing and certification capabilities cover all types of PV modules, PV auxiliary parts and components, PV system balance components, energy storage equipment and systems, PV power plants and other fields. As of May 2023, TN Group has completed more than 80GW of global PV products and PV systems assessment volume, whole-process quality supervision, pre-shipment inspection and other services, helped many domestic and foreign enterprises to connect their energy storage systems to the power grids of various countries, and completed more than 800 grid-connected certification projects. With good cooperation with PV access organizations in most of the countries in the world, TN Group helps PV enterprises to quickly complete market access in many countries and regions through the service of "One Inspection, Multiple Certificates", which covers the whole world. TN Group's PV product testing and certification capabilities cover the entire PV module, PV auxiliary components, PV system balance components, energy storage equipment, PV power plants, etc. TN Group has abundant PV product testing resources at home and abroad, with multiple IECEE-CB laboratories and large testing capacity (TUV NORD website, 2023).

4.2 Analysis of Industry Competitiveness

This part uses Porter's Five Forces model to analyze TN's competitive environment in the field of PV certification in depth from four aspects: bargaining power of suppliers,

bargaining power of purchasers, threat of potential competitors, and threat of existing competitors (the threat of substitutes in the field of PV certification does not exist and is not analyzed here).

4.2.1 Supply-side bargaining power

In this field of PV module certification, suppliers mainly play the role of providing PV module testing services. Due to the large scale of investment in PV laboratories, most laboratories are funded by the government, such as Yangzhou Photovoltaic in Yangzhou, Chengdu Quality Inspection in Chengdu, and State Inspection in Beijing. In response to these suppliers with a strong desire to bargain, we will focus on certification bodies that have chosen to outsource the testing process to third parties, such as DK and S, among others. The certification strategy adopted by these organizations is often to hand over the experimental work to external laboratories for operation, so that the price charged by the laboratory has a direct impact on the certification costs and profit margins of these certification bodies. The famous German testing organization TN, for example, has its own R & D laboratory, the vast majority of PV module product testing can be completed in their own test chamber, so it does not face the trouble of supplier bargaining. More importantly, in this case, TN will not be constrained by suppliers.

4.2.2 Bargaining power of buyers

For certification services for PV module products, buyers have very limited bargaining power.

First of all, because for the PV module product certification services for the number of buyers, 2022 in China into a large-scale PV module production enterprises reached about 373, from the purchase of the volume does not constitute a negotiating advantage over the seller, so limiting the bargaining power of the buyer. And the volume of its purchase services but very small: basically limited to 250,000-500,000 yuan between, and repeat purchase of a longer period of time, basically 1 year, in the field of PV module certification, the strength of the supply side and very large, are

foreign certification bodies of the giant, and certification bodies of the certification fee is basically fixed, can float the space is very small, so, also limits the bargaining power of the buyer.

Secondly, PV module certification is not a standardized service, and the services of each certification body are different (differently marked certificates), so there will be no obvious comparability in service comparison. This also contributes to the low bargaining power of the buyer.

Finally, because TN has a global market share of about 50% in the field of PV module certification with the EU as the sales market, resulting in a very large market influence, and many buyers' customers also specify that the module manufacturers provide TN's certificates before purchasing them, which even more restricts the buyer's selectivity, thus exacerbating the suppression of the buyer's bargaining power, resulting in the low bargaining power of the buyer to form the result of the The status quo of seller's market.

4.2.3 Threat of new entrants

In the field of PV module certification, new entrants have not yet posed a threat to TN Company Inc. Certification industry has its own special characteristics, if a certification body in a particular industry to enter earlier, and soon occupy a certain market share, and in the industry to form a large brand impact, other competitors will be very difficult to have a great deal of action in the field. Such as the ship inspection certification industry in the company D and company B, wind power certification industry, company G and so on.

Moreover, the certification industry has high barriers to entry. First, the certification qualification. Certification qualifications need to pass a rigorous review, including the certification body's system, practitioner qualifications and competencies, etc., the second, the investment of funds. Second, the capital investment. Generally, as a certification body, the capital investment in personnel and laboratories, etc. is very large. Third, the return on investment considerations. If a new industry entrants think

that it is difficult to have a large market share in the industry, its investment must be exploratory or conservative, and as a result, it will not be great as in the industry. In the PV module certification industry, the minimum investment for a medium-sized PV laboratory is about 40 million RMB. So far, new competitors have coincidentally chosen to cooperate with the laboratory business model, in order to avoid the results of the income can not make ends meet.

Finally, in the field of photovoltaic module certification, qualified and capable large foreign certification bodies have entered the market successively, so there will be no more powerful certification bodies to enter the field of photovoltaic certification in the later stage of the competitive market environment.

4.2.4 Degree of competition from competitors in the same industry

In the field of PV module certification, where the EU is the main sales market, TN holds a market share of about 50%, forming a leading market position. Although there are many powerful foreign certification organizations as competitors, it has a solid and stable market position that is difficult to shake. Moreover, the high cost of investment in PV module certification laboratories and the use of very specialized experimental equipment make the exit cost in this PV certification field very high, making it difficult for competitors to make large investments in the industry without achieving certain market gains, thus also reducing the competitiveness of competitors in disguise.

However, the entry of many strong foreign certification bodies into the field of PV certification in various ways has had a certain impact on TN's profit growth rate. 2023 certification fees are about 50% lower than in 2016, offset by the continued increase in the number of certifications. Therefore, in the field of PV module certification, the main competition is still among foreign certification organizations other than TN, and the degree of competition is not high for TN.

To summarize, in the field of PV module certification, TN has a clear leading competitive position, and some key competitive factors do not have a direct impact on

TN's business. Moreover, TN has continued to expand its leading position on the basis of its existing competitive position, such as by investing in PV laboratories, increasing service contents, lowering service prices and increasing publicity, etc. to continuously widen the distance between TN and its competitors, so that TN can continue to maintain its leading competitive position. At the same time, TN is always alert to competition in the industry and reacts promptly to key influencing factors to maintain the market position it has achieved.

4.3 Competitive analysis of PV product certification business

This section uses a competitive landscape matrix to identify TN's competitors in the certification business and analyzes competitor objectives to determine competitors' strengths and weaknesses, as well as analyzing TN's key competitive positions to lay the groundwork for the next step in determining competitive strategy.

4.3.1 Identification of major competitors

Selecting the Competitive Profile MaTCix, by establishing the key factors and their influence weights, and calculating them after scoring, it is possible to directly find TN's main competitors in the PV product certification business, which, according to the ranking of the scores in Table 4.1, are, in order of priority, the TC, TS and V companies.

Table 4.1 - Competitive Landscape Matrix Analysis of TN Company, Inc.

Critical factor	Weight	TN		TS		TC		S		I		V	
		Score	Weighted score	Score	Weighted score	Score	Weighted score	Score	Weighted score	Score	Weighted score	Score	Weighted score
Market share	0.1	5	0.5	3	0.3	5	0.5	3	0.3	1	0.1	2	0.2
Service level	0.3	4	1.2	4	1.2	4	1.2	2	0.6	2	0.6	2	0.6
Price	0.1	3	0.3	2	0.2	2	0.2	5	0.5	4	0.4	5	0.5
Time	0.2	3	0.6	3	0.6	4	0.8	3	0.6	5	1	4	0.8
Brand	0.1	5	0.5	4	0.4	4	0.4	4	0.4	2	0.2	3	0.3
Technical capability	0.2	5	1	3	0.6	4	0.8	2	0.4	2	0.4	3	0.6
Total	1		4.1		3.3		3.9		2.8		2.7		3
Ranking			1		3		2		5		6		4
Note: The meaning of rating values is 1=weak, 2=second weak, 3=moderate, 4=second strong, 5=strongest													

Source: Questionnaire survey and internal information of the author's company

4.3.2 Market objectives of major competitors

TC company entered the Chinese certification market earlier, in the field of photovoltaic certification has also been in a leading position, in recent years, the company's main focus on maintaining large customer relationships, the photovoltaic market is developing more rapidly, ignoring the growth of smaller enterprises, resulting in the loss of many small and medium-sized enterprise customer base, and thus in the market share of the occupancy rate of the declining trend is obvious.

Since entering the Chinese certification market, TS has not been very concerned about the size of its market share, but is very concerned about profitability. Each branch operates in an independent market with regional management and independent accounting, with little pressure on market operation. Therefore, in the actual operation process, we have been pursuing the goal of steady development.

PV module certification has been out of the Shanghai office of the company V is a non-profit third-party certification body in Germany, and in China does not have independent laboratories and financial rights, but only as a certification program for the acceptance of the work of the department. So the pressure of the industry's certification services indicators are not in China, which also leads to the problem of

lack of motivation, and the agency's market objectives in China does not take the photovoltaic product certification as the main item of their own business, so the V company's market objectives are mainly to maintain the market as the main.

The business strength of the S Corporation organization is not in the field of photovoltaic certification, but rather focuses on services such as chemical testing and inspection. Because it was only after the acquisition of TI that it hoped to enter the photovoltaic certification market through the agency's qualification to issue TUV certificates, S Corporation did not, from the outset, pay too much attention to the field of photovoltaic certification, so S Corporation in the field of photovoltaic certification with the market penetration as the main goal.

4.3.3 Strengths and Weaknesses Analysis of Major Competitors

TC has its own laboratory and entered the Chinese market earlier, which gives it a certain advantage in terms of reputation and market share. Its disadvantage lies in the loss of technical and sales staff in recent years, as well as the neglect of small and medium-sized customers, leading to a further decline in market share. On the other hand, the high price of TC Company's certification is also an important reason for its lagging behind in competitiveness.

TS's competitive advantage in the PV field is that it has the T-brand name recognition, and the company has not invested in its own PV laboratory, so there is basically no pressure on the cost side. After TS company entered the field adopted a flexible market expansion means, through a series of market behavior, occupy a certain market share. However, the disadvantage is that, because of the method of laboratory outsourcing, which makes the engineers' technical ability is not high, so the technical services provided to the customers are less, and it will appear to be less professional. At the same time, because of the late entry into the market, enterprise awareness still need to be gradually established, which will directly its competitiveness decline.

Company V entered the field of PV certification at a similar time as TN. So it has

accumulated a certain technical ability and brand awareness. However, because the company's marketing is not in place, not with the market position has been achieved to continue to expand the market, but to take the business of the business approach, so that the market position is gradually declining. Because V China is only similar to the business acceptance office, all the project implementation such as contract signing, testing, issuing certificates, etc. are all done by Germany, so that the customers in China will feel that the service is not enough.

S Corporation The company is market-oriented, so the project is operated with great flexibility and accepts fewer businesses, which allows it to give sufficient commitment to its customers in terms of certification time. At the same time, because it has the qualification of issuing T-mark certificates, it has a certain degree of brand awareness. However, because of the late entry into the market, the technicians in China have insufficient experience and technical ability, so they can only compete with competitors in terms of price and cycle time, and their service ability is weak.

4.3.4 Competitive Behavior Analysis of Major Competitors

In terms of the overall market competition, TN and TC are in the leading position in the PV product certification market because of their strong brand recognition, independent PV laboratories and global market share of about 30%. TS company, because of the same TUV brand, flexible market expansion behavior and strong company background support, in the field of photovoltaic certification, especially amorphous photovoltaic module certification market has achieved a certain degree of precedence, so that TS in the market challenger position. For V and S, they have low market share and do not have much of a lead, which puts them in the position of market follower.

Because of the different market positions of the competitors, the competitive behavior of each company in the field of PV certification is also different. TS and TC have been actively seeking direct competition with TN based on the market share they have already gained, and now TN faces the challenge of these two companies in

almost every new project. They have been actively compensating for their competitiveness by strengthening market promotion, establishing horizontal cooperation in various aspects and increasing service content to enhance their competitive edge with TN. In the future, TN will face more challenges from these two companies.

Companies V and S themselves do not look at the PV certification field, so their actual competitive activities in the PV certification field are limited; they only use some marketing campaigns to strengthen their visibility and influence in the PV industry. However, S itself has a very high degree of market flexibility and often uses price wars to compete with other competitors, even if it loses the project, it will have some impact on the profit margins of its competitors.

4.4 Summary of the chapter

From the above introduction of TN's PV certification business and the use of Porter's Five Forces model analysis, TN has a clear leading position in the field of photovoltaic certification, and such a competitive position in the short term is difficult to be surpassed by competitors; at the same time the use of the competitive profile matrix (Competitive Profile MaTCix) analysis, derived from the main competitors of the TN company. At the same time, using the competitive situation matrix (Competitive Profile MaTCix) analysis, the main competitors of TN Company were identified; this also lays the foundation for the next step of using SWOT to analyze the choice of TN Company's competitive strategy.

5. Competitive strategy analysis and discussion of TN Company's firms

Through the SWOT analysis, combining the opportunities and threats (external environment) and the strengths and weaknesses (internal environment) of the company, a matrix analysis is carried out, and combined with the analysis of the competitive position of each company in the industry in the previous chapter, it is concluded that the competitive strategy suitable for TN in the field of photovoltaic certification at present is the differentiated competitive strategy.

5.1 Analysis of competitive strategy options

According to the factors of strengths, weaknesses, opportunities, and threats of other certified companies and TN as explained above, a SWOT matrix analysis model is constructed, and the construction of a SWOT is divided into the following steps:

List the internal strengths of the business

List the internal disadvantages of the business

List external opportunities for the business

List external threats to the business

Match internal strengths with external opportunities to get SO strategic program

Match internal disadvantages with external opportunities to get a WO strategic program

Match internal strengths with external threats to get a ST strategic program

Match internal disadvantages with external threats to get a WT strategic program

Through the analysis in Table 5.1, combined with Table 4.1, we can see that TN has advantages in market share, technical ability, ability to develop new business and reputation, as TN's competitors, who are eyeing on the PV certification market, are mostly competing with TN by means of lowering prices, and they do not have advantages in the field of technology and cooperation with customers. Therefore, it is not in TN's long-term interest to adopt a centralized strategy and cost strategy, and

adopting a differentiated competition strategy means to widen the gap with rivals in terms of branding, marketing methods and technical services, and to occupy and expand the market share.

Table 5.1 - TN Corporation PV Certification Business SWOT Analysis Table

Internal capabilities Externalities	Strength	Weakness
	● High brand awareness ● The largest market share ● Multiple laboratories ● Strong technical ability ● Rich human resources ● The customer has a good reputation for TUV NORD ● Strong ability to develop new business	● Long certification cycle ● High certification fees ● Weak service awareness ● Lack of marketing ● Slow reaction to competition
Opportunities	SO	WO
● The growth rate of the photovoltaic market continues to increase ● New production manufacturers increase ● The decline in product quality promotes the requirement for certification ● Government subsidies and certification linked to overseas markets	● Actively expanding new customers ● Establishing strategic partnerships with key existing clients ● Improve relationships with major international market governments and banks ● Establishing better mutual assistance relationships with major buyers	● Increase the number of technical personnel ● Expanding laboratory capacity ● Improve efficiency and reduce costs ● Strengthen the execution of management details and enhance marketing efforts
Threats	ST	WT
● Increased attention and investment from competitors in the photovoltaic industry ● The loss of new customers leads to a decrease in industry influence ● The potential impact of financial impact on the usage of new energy products	● Increase investment in personnel and laboratory construction ● Enhance the intensity of horizontal strategic cooperation and enhance service capabilities ● Increase the speed of market share	● Continuous attention to key potential customers ● Regularly hold industry training and strengthen relationships with customers in the photovoltaic industry ● Maintain tracking of lost customers and strive for new cooperation opportunities - Strengthen management quality

source: questionnaire and internal information of the author's company

5.2 Specifics of the competitive differentiation strategy

This section specifies the competitive differentiation strategy adopted by TN in terms of brand differentiation, service differentiation and marketing tool differentiation.

5.2.1 Brand differentiation strategy

In terms of branding, in the face of increasingly fierce globalized brand competition today, the brand itself is no longer just a name, a logo or a synonym for a concept. The brand has now become a clear impression in the minds of consumers, whether the enterprise provides consumers with services or direct products, the brand is more conveyed by an intangible asset of the enterprise. In the current competitive market environment, branding has become a very important competitive tool, and the market-tested brand itself can be a typical competitive advantage of an organization (Jia, 2013).

Brand differentiation can effectively reduce the magnitude of consumer information asymmetry, thereby gaining consumer trust and improving the market competitiveness brought by the brand.

The TN Group's brand differentiation strategy has also been refined through continuous change, with the brand strategy responding to actual changes and needs in the marketplace.

In the early stage of the development of the PV certification market, when TN first entered the PV certification market, there were only a limited number of strong competitors in the market, and its main competitors at the initial stage were V and S. Because of the obvious differences in the company brands and certification marks, TN Group mainly used T as the brand object to facilitate customers' memory and promotion. Because of the obvious difference in the company brand and certification mark, in order to facilitate customers to remember and publicize, TN Group at that time, mainly to T as the brand object for the appropriate communication and promotion, at the same time, V and S companies are also to abbreviate the market expansion. In the PV industry, customers have recognized T Certification as the most authoritative certification brand in the field of PV certification, and it can be said that

it is a household name. It can also be considered that TN Group has achieved a milestone in the promotion of its own brand.

Through continuous efforts, customers in the field of photovoltaic certification now know the difference between TN and TS and TC in the photovoltaic industry, which effectively reduces the problem of choosing the wrong certification body because PV companies do not understand the significant differences that exist between the three certification bodies.

A brand differentiation strategy is very important for companies leading in an industry and at some point can even determine the future of the company. By establishing an enhanced branding strategy, the TN Group of Companies has been able to maintain its leading position in the field of photovoltaic certification and effectively differentiate itself from its competitors.

5.2.2 Service differentiation strategy

The key to a firm's competitive advantage in providing different or better quality services to its target customer base than its competitors, especially when it is difficult to differentiate between tangible products, is often determined by the quantity or quality of the services provided by the firm, which is referred to as the service differentiation strategy (Liu, 2008).

For TN Group, facing the increasingly competitive PV certification market, which is characterized by small technological differentiation, similar prices and similar certification cycles, TN Group's PV certification department, through the analysis of its own internal strengths and weaknesses, as well as the investigation and analysis of the actual needs of customers for PV certification, has made clear the differentiation of the competitive strategy to improve the pre-sales and after-sales services.

In the field of photovoltaic certification, most of the photovoltaic production enterprises are the first time to operate the certification, the enterprise itself for the certification of photovoltaic modules do not have enough experience, and at the same time on whether they can successfully pass the certification does not have sufficient

confidence. The authors of this paper in their daily work and certification demand exchanges, the other side asked the most questions are, has been certified by the enterprises to choose the material manufacturers have? What are the main items easy to fail? How to avoid the problem of test failure? Through the above market feedback, TN conducted an effective analysis. It finally concluded that it has leading technological advantages, which can be translated into pre-sales services for PV manufacturers, thus improving TN Group's competitive advantages in the field of PV certification. Therefore, since 2016, TN Group has transformed from a single certification service to a consulting plus certification service model, by increasing the consulting services before certification and solving the issues of concern to the enterprises, thus effectively improving the reputation as well as the competitiveness of TN in the field of photovoltaic certification.

After proving that the strategy of service differentiation can effectively improve the competitiveness of enterprises, TN Group has developed a variety of new services in the field of PV certification to help PV enterprises to improve their own technical capabilities and the quality of PV products. The TN Group has been helping PV manufacturers to design and plan their own PV laboratories, and has been the first in the PV industry to promote PV module inspection services and power calibration of PV module testing equipment, etc. The TN Group has been able to use its technological capabilities to continually improve its service level and differentiate its services from those of its competitors, thus increasing the competitiveness of the TN Group in the field of PV certification.

5.2.3 Optimizing competitive differentiation strategies through marketing tools

5.2.3.1 Effectiveness of marketing differentiation in TN companies

For companies wishing to expand their competitive advantage through differentiated competitive strategies, differentiation itself requires not only the provision of differentiated services by the company itself, but also the use of PR and advertising and other marketing tools to effectively and rapidly expand the market impact of the differentiation strategy. Traditional marketing methods basically only focus on the

combination of key factors such as product, price, channel and promotion, but for modern marketing, it is more important to pay attention to the impact of Internet marketing and other means on the marketing results. After the research of TN's sales department in the existing customer base, the vast majority of PV module manufacturers are through Internet searches and word-of-mouth within the industry to learn about the TN company's services in the field of photovoltaic certification. The vast majority of PV module manufacturers learned about TN's services in the field of PV certification through internet search and word-of-mouth in the industry. Therefore, TN Group pays more attention to online marketing to improve its influence and competitiveness in the field of photovoltaic certification through effective use of marketing tools. In terms of network marketing, we have chosen the method of precision marketing in the face of different customer groups. Because the customer base in the field of photovoltaic certification is narrow in scope, it is easier to determine the scope of the customer base. TN Group cooperates with domestic and overseas famous industry websites and magazines to carry out advertisement, enterprise and technical services to effectively increase the exposure rate of TN in the photovoltaic industry, so that the potential customers can effectively look for the information of TN Group, and improve the effectiveness of the communication channels between TN and the potential customers. The effectiveness of the communication channels between TN and potential customers has been improved. According to TN's internal statistics, about 50% of new customers learn about TN's information in the field of photovoltaic certification through the Internet and make business contacts.

TN's differentiated competitive advantages in the field of photovoltaic certification can be significantly optimized through a variety of marketing tools, so that customers can learn from a variety of channels the benefits brought to customers by TN's differentiated competitive strategy and the differences between TN and other competitors, thus achieving the purpose of improving TN's competitiveness.

5.2.3.2 Problems in marketing at TN

Currently with the development of marketing, the concept of marketing is gradually changing with the development of the society. TCCout (2004) in Jack TCCout 特 on Strategy mentions that the latest definition of marketing mission by The New Marketing is: "Integrating corporate resources to maximize corporate profits." Therefore, marketing management should be a very important department in the enterprise, playing the role of enterprise development navigation.

Each business area of the TN Group of Companies is individually burdened with the pressure of sales targets, but TN has always existed and developed as a non-profit third-party organization since its inception. Due to the above factors, the TN Group of Companies does not attach great importance to marketing like other companies in other industries. In the beginning, the role of the marketing department was mainly to organize exhibitions, collect information about competitors, make gifts, publish advertisements and order promotional materials. It can be seen that TN's marketing department has insufficient rights to the planning, execution and other levels of corporate marketing, therefore, causing the problem of disconnecting marketing and sales, with each department doing its own thing while seldom supporting each other. In the photovoltaic certification industry, most of the information collection, industry analysis and the selection of industry exhibitions and events are executed by the sales department. The main role of the marketing department in this is the support of marketing activities. But this will produce the problem of inversion of the art, the main work and strengths of the sales department should be in the development of new markets, maintenance of old customers and in the confrontation with competitors to win, and many marketing specialties such as demand forecasting, price setting, market research and marketing effectiveness evaluation of the work of the marketing department's strengths.

Therefore, there are still some problems in the marketing work of TN Company Group in the PV industry, but at the same time this is also an opportunity for development, as long as by improving the lack of marketing work of TN Company, the marketing activities will bring greater market results for TN Company Group.

5.3 Planning of TN's competitive strategy

This section sets out a series of plans for locking up large customers with vertical strategic cooperation, expanding related businesses, and horizontal strategic cooperation based on the differentiated competitive strategy adopted by TN.

5.3.1 Targeting large customers with vertical strategic cooperation

The TN Group of Companies, now in its 154th year, continues to maintain its leading competitive position by adapting its competitive strategy in the field of photovoltaic certification to the actual needs of the certification market through changes in the market and demand.

The global market demand for photovoltaic module products continues to grow, and, with the investments made by Chinese companies in the photovoltaic field over the past two years, China has become an important global production base for photovoltaic module products. China's photovoltaic module production and installed capacity has jumped to the world's No. 1 market position, with close to 500 manufacturers of all photovoltaic modules. With such a large potential customer base, the TN group of companies sees great potential for the development of this business in the China region as well as in the Asia-Pacific region. Therefore, TN has set up a laboratory in Suzhou, China, to provide direct localized services to customers in China and the Asia-Pacific region, to directly support the huge potential demand of the market, and to avoid the loss of potential customers due to the capacity of the laboratory. This completes TN's presence in major global markets such as Europe and Asia-Pacific, and makes the TN Group a leading international certification body in the field of photovoltaic certification.

In line with the rapid development of the Chinese market, TN Group's PV Industry Leader has signed a strategic cooperation agreement with China Quality Certification Center (CQC) and Beijing Check & Balance Certification Center (BCCC). The mutual recognition of reports will help Chinese PV module manufacturers to reduce the burden of certification and improve efficiency. The

signing of this agreement enables TN Group to continue to maintain and expand the market share as well as the influence of TN's certification mark in the Chinese PV sector.

As can be seen from the presentation of TN Company's strategy for 2015-2022, while the overall PV market is subject to a variety of changes and impacts on the PV certification sector, the TN Company Group's ability to continue to maintain its leading position in the changing market environment is primarily gained through the adjustment of its market strategy to keep pace with the times.

5.3.2 Expanding related businesses to assist PV certification

Since 2006, the global market demand for PV module products has grown exponentially, and the huge growth rate of demand has exceeded the actual production and supply capacity of PV module enterprises, resulting in a situation where the demand exceeds the supply. Because of the strong market demand and the temptation of high sales profit of PV module products, a lot of quality problems occurred around 2007, such as selling second-rate products as good ones and selling waste products as genuine ones, which were even more common among Chinese PV module manufacturers, and seriously affected the image of Chinese PV product manufacturers in the global market.

TN Group China analyzed the above phenomenon to be a very good potential market opportunity, and then immediately through TN's professional and fair image in the PV industry, the market's huge influence and TN Group's technical capabilities in the PV certification industry to take the lead in the launch of the PV module inspection related services. Through the joint promotion of Chinese PV enterprises and international buyers, the inspection business developed rapidly from scratch and became a new profit growth point in the PV industry, making a great contribution to the performance index of the year.

The launch of the goods inspection service can be a very good solution to the above problems. Firstly, for Chinese module manufacturers, TN Group's influence

and authority in the PV industry can help them improve their corporate and product image from a third-party point of view, so as to gain more recognition from buyers and increase their sales share and sales price. Secondly, for international buyers, it can help them avoid procurement risks and reduce losses. For TN Group, the promotion of goods inspection business can not only improve the sales performance by providing new services, but also gain the recognition of international buyers through communication and cooperation with them, so that the TN Mark Certification can become their designated certification mark, and achieve the purpose of continuous expansion of the certification business, and thus, through the requirements of the buyers for the certification of PV product suppliers, TN Group can directly gain a competitive advantage over competitors in the field of PV certification. By the requirement of PV product supplier certification by buyers, TN Group can directly gain an advantage over competitors in the field of PV certification, so that the non-compulsory TN Company Mark Certification becomes a mandatory requirement of buyers in disguise, and becomes the only choice of PV module production enterprises in disguise. By providing PV module inspection services, the TN Group of Companies, which has already achieved a leading competitive position, has continued to improve its market competitiveness, increased its market influence, consolidated its competitive position, and continued to distance itself from its competitors.

5.3.3 Horizontal strategic cooperation helps to consolidate the leading position

5.3.3.1 Establishing strategic cooperation with domestic certification bodies

TN's strategy for market expansion is not only to rely solely on the strengthening of its own forces, but also to engage in strategic horizontal cooperation with many peer companies in the PV module industry. For example, TN started to cooperate with Chinese certification organizations to bring customers one test and two certificates. This has become a milestone for TN to start horizontal cooperation with Chinese enterprises.

Through the above horizontal cooperation model, TN continues to maintain a good relationship with Chinese certification organizations, and both parties work

together to promote the development of the PV certification market in China. Through this strategic cooperation agreement, we can solve the problem of duplicated testing for PV module manufacturers in China, and reduce the cost of PV manufacturers and improve the competitiveness of PV manufacturers. Moreover, through this cooperation, TN Group has become one of the foreign certification organizations that have established strategic partnerships with two authoritative domestic PV certification organizations in China. Through the further implementation of the cooperation agreement, TN Group will continue to maintain its absolute leading market position in the field of PV certification in China, and its influence and authority in the industry, which will further widen the distance with its competitors.

5.3.3.2 Mutual recognition cooperation with foreign licensing bodies

The PV module products produced by Chinese PV companies are not only sold to the European and Chinese mainland markets, but are also widely used in other parts of the world. Therefore, establishing cooperative relationships with foreign certification bodies is also a very important means to help Chinese PV enterprises reduce costs, improve efficiency and enhance competitiveness. TN Group of Companies has not neglected the expansion of horizontal cooperation in the above aspects as well.

TN Company Group has established a cooperative relationship with CEC Australia. Through the mutual recognition of the CB system, recognizing the test data of TN Company Group on PV modules, only need to transfer the certificate, can directly issue the Australian CEC PV certification mark. Through this kind of horizontal cooperation, it can greatly reduce the burden of PV production enterprises and shorten the certification cycle which is of great concern to the PV certification industry. Through the above strategic cooperation, most of the PV module enterprises in China wishing to export to Australia will choose TN's certification mark to transfer to Australia CEC's certification pathway, which in effect expands TN's certification mark's industry influence and market share.

In 2008, the United Kingdom through the Microgeneration Certification Scheme

(MCS) established the MCS certification mark for the use of local PV products in the U.K. Through the analysis and judgment of the potential market demand, TN Group timely established a strategic cooperative relationship with the U.K. MCS to enable MCS to establish a test report recognition mechanism with TN Group, and to facilitate Chinese PV manufacturers to obtain the MCS certification. TN Group has established a strategic partnership with MCS in the UK through the analysis and judgment of the potential market demand, so that MCS and TN Group can establish a test report recognition mechanism, and establish a convenient PV module product certification mechanism through the similar mode of cooperation with JET in Japan, which is convenient for the Chinese PV manufacturers to obtain the MCS certification certificate.

The above introduction is only part of the horizontal strategic partnership between TN and other certification organizations. Through the establishment of horizontal strategic partnership, TN Group will have a part of impact and loss in terms of single certification revenue, but through the establishment of horizontal strategic partnership on a global scale, it plays a very important role in expanding the market share of PV certification, increasing the influence of TN Group in the field of PV certification, improving the recognition of TN certification mark by customers and improving the competitiveness. The role of the TN Group is very important. Based on TN Group's existing competitive advantages, and through the establishment of more horizontal strategic cooperation with other certification bodies, TN Group not only consolidates its existing advantageous market share, but also further distances itself from its competitors and improves its profitability.

6. Conclusions and recommendations

6.1 Conclusion

As one of the world famous multinational certification organizations, TN Group has achieved a leading market position in the field of photovoltaic certification after more than 14 years of rapid development from scratch through its own continuous efforts. After the argumentation of this paper can be seen, TN Group's above achievements, mainly through the selection and implementation of differentiated competitive strategy to achieve. TN Group has adopted a differentiated competitive strategy manifested in brand differentiation, service differentiation, marketing tools differentiation.

Through the above competitive strategies, TN Company Inc. and its competitors generate advantages in the field of competition in PV product certification in terms of technological leadership, advantages in service branding and advantages in basic innovation. Through the above advantages, TN Company Inc. continuously strengthens the durability of competition and improves the ambiguity in the field of photovoltaic certification through the strategy of technological leadership. After obtaining early profits, it has gained a leading position in the market by rapidly building laboratories with high exit barriers and rapidly capturing the market to expand the industry's influence. Innovation and technology leadership strategy is the basis of TN Company's company in the field of photovoltaic certification to achieve leadership in the innovation and differentiation strategy, is through the establishment of strengthened brand differentiation strategy, service differentiation strategy, and other methods so that the TN Company Group in the field of photovoltaic certification has been to maintain a leading position, and effectively differentiate from competitors. The implementation of the above strategies has effectively improved the competitiveness of the TN Group in the field of PV certification.

TN Group proposes to set a series of vertical strategic cooperation to lock up large customers, expand related business, horizontal strategic cooperation and other

aspects of the specific plan, not only to enable TN Group to expand the market share of PV certification, but also to increase the influence of the TN Group in the field of photovoltaic certification in the market. Based on the existing competitive advantages of TN Group, and through the establishment of strong horizontal strategic cooperation with other certification organizations, TN Group not only consolidates its existing advantageous market share, but also further distances itself from its competitors and improves its competitiveness.

The successful implementation of the above strategies is the fundamental reason for the TN Group's market-leading position in the field of certification of photovoltaic products.

6.2 Recommendations

From the above summary, although TN Group has gradually established a leading position in the field of photovoltaic certification in the photovoltaic certification industry through differentiated competition and other strategies, but at the same time, we should still see that the group in the implementation of the leading strategy in the process, there are still some minor flaws.

In terms of marketing, TN also needs to continue to utilize the marketing department's expertise to strengthen research, market analysis and promotion in the PV certification market. Through the marketing department's expertise in marketing, TN will continue to strengthen the contribution of marketing to sales performance.

Finally, in terms of sales management, TN needs to solve the problem of internal competition as soon as possible, through the refinement and strengthening of management, to avoid the problem of inter-regional robbing orders, so that TN's sales unity and cooperation, and unanimously compete with competitors, to improve the overall sales performance of the company.

6.3 Limitations of this paper

Because of some subjective and objective factors, this thesis still has some

deficiencies. Due to limited access to information, important information about competitors is mainly obtained through industry websites, magazines and my own experience in the field of photovoltaic certification, and some specific information is difficult to obtain confirmation, and in some cases, it is impossible to obtain. Also due to time constraints, the author draws on limited academic literature, data and quantitative analysis is also very insufficient, so the relevant arguments may not be scientific. It is hoped that in the future, the author can strengthen the literature reading and improve the methodology in the spare time of his work, and continue this research, especially the changes of the competitive environment in the field of photovoltaic certification and the continuous tracking and investigation of TN's subsequent competitive strategy.

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8. Appendices

Appendix A - [Questionnaire]

Basic information about the respondents

- | | |
|---|--------------------------------------|
| | 1) Third party testing organizations |
| | 2) Distributors |
| | 3) Financial institutions |
| 1. What is the nature of your company? | 4) EPC |
| | 5) Purchasers |
| | 6) Manufacturers |
| | 7) Others |
| | 1) Jiangsu |
| | 2) Zhejiang |
| | 3) Shanghai |
| | 4) Anhui |
| | 5) Northeast China |
| | 6) Shandong |
| 3. Where is your company located? | 7) Hebei |
| | 8) Henan |
| | 9) Jiangxi |
| | 10) Beijing |
| | 11) Guangdong |
| | 12) Overseas |
| | 13) Others |
| | 1) ≥ 10 million |
| | 2) 5-10 million |
| 3. How much does your company spend annually on certification services? | 3) 2-5 million |
| | 4) 1-2 million |
| | 5) 500-1 million |
| | 6) 0-500,000 |

7) Unknown

4. Does your company consider certification important to your company?
- 1) Not important
 - 2) Average
 - 3) Important
 - 4) Very important

Respondents' choice of certification body

4. Which certification bodies are commonly used in your company?
- 1) I mechanism
 - 2) S mechanism
 - 3) V mechanism
 - 4) TC mechanism
 - 5) TS mechanism
 - 6) TN mechanism
 - 7) Other mechanism
5. Which company has a short testing and certification cycle?
- 1) I mechanism
 - 2) S mechanism
 - 3) V mechanism
 - 4) TC mechanism
 - 5) TS mechanism
 - 6) TN mechanism
 - 7) Other mechanism

6. Which certification company do you think is cheaper?

- 1) I mechanism
- 2) S mechanism
- 3) V mechanism
- 4) TC mechanism
- 5) TS mechanism
- 6) TN mechanism
- 7) Other mechanism

7. Which certification company do you think has a better level of service?

- 1) I mechanism
- 2) S mechanism
- 3) V mechanism
- 4) TC mechanism
- 5) TS mechanism
- 6) TN mechanism
- 7) Other mechanism

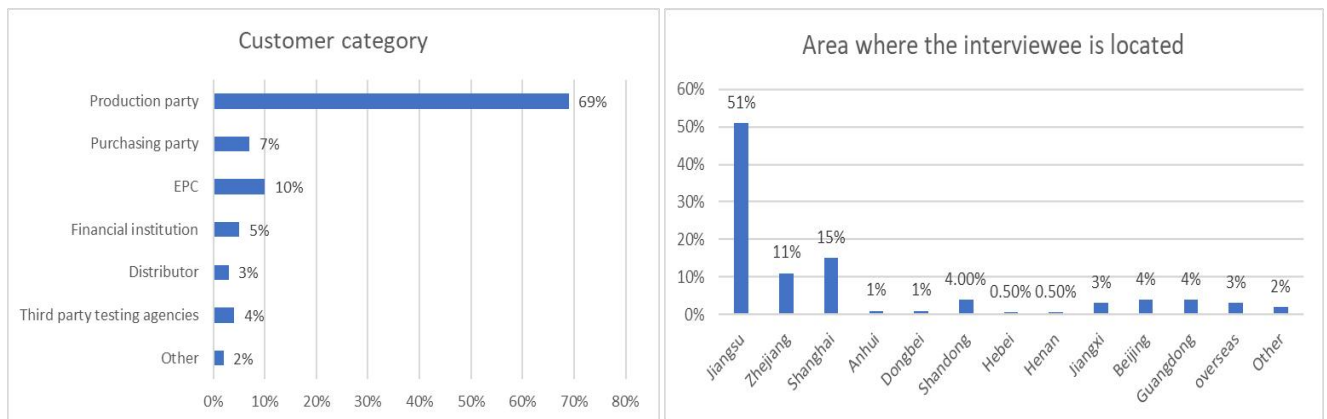
8. Which certification company do you think is leading in terms of technical capabilities?

- 1) I mechanism
- 2) S mechanism
- 3) V mechanism
- 4) TC mechanism
- 5) TS mechanism
- 6) TN mechanism
- 7) Other mechanism

Appendix B -Summary of Questionnaire Data

Through SPSS software coding to establish a data file to analyze the returned questionnaires, through the centralized trend analysis to obtain the current photovoltaic product certification customer groups are mainly manufacturers, accounting for 69%, the main distribution area for Jiangsu, Zhejiang and Shanghai and other places. See Figure Appendix 1 and Appendix 2

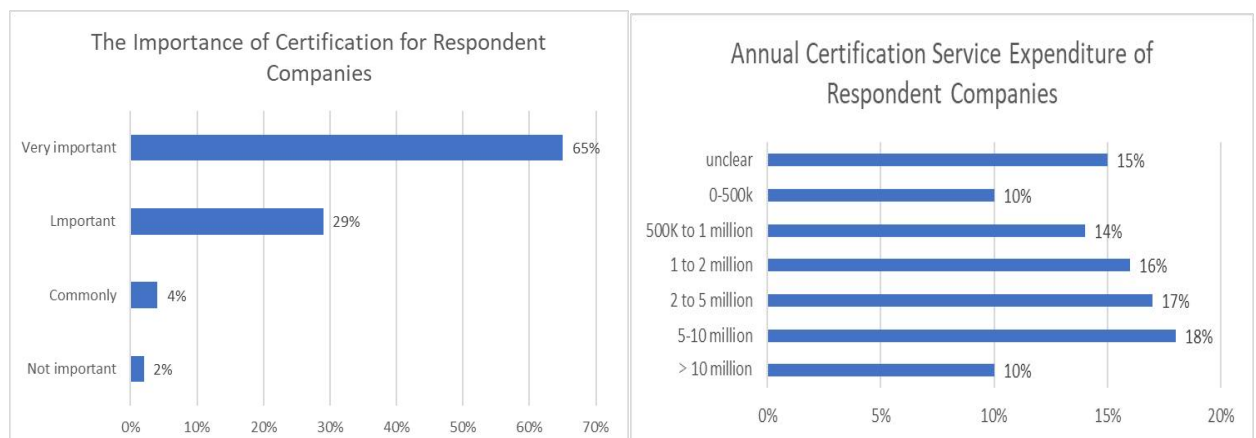
Figure Appendix 1 and Appendix 2 - Analysis of respondents' basic information



Source: Based on data from the data questionnaire, compiled by the authors.

After analyzing the data, 65% of the respondents believe that certification services are very important to their company's products, affirming the importance of certification services in PV products. 61% of the respondents' companies spend more than \$1 million per year on certification services, with 28% of their clients spending more than \$5 million. See Figure Appendix 3 and Appendix 4

Figure Appendix 3 and Appendix 3 - Respondents on accreditation recognition and



financial investment

Source: Based on data from the data questionnaire, compiled by the authors.

After data analysis, 74% of the respondents believe that the commonly used PV certification bodies are TC organization, TS organization, TN organization; 27% believe that I organization has the shortest test cycle; respondents believe that the organization with the lowest cost is I organization, V organization and S organization accounted for 68% of the total; the level of service and technical ability in the interviews are 24% of the respondents believe that TN is the optimal. See Figure Appendix 5, Appendix 6, Appendix 7, Appendix 8 and Appendix 9.

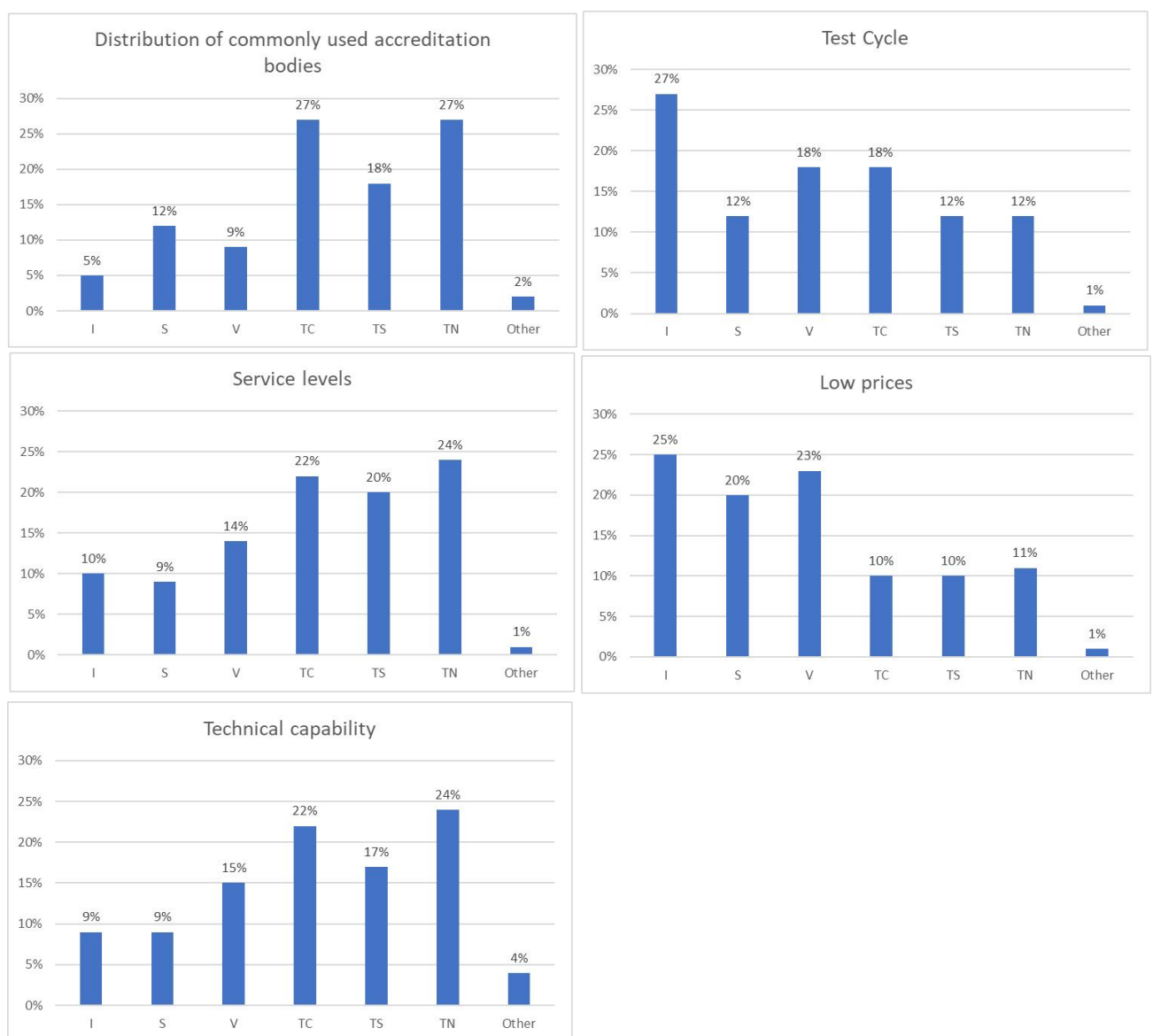


Figure Appendix 5, Appendix 6, Appendix 7, Appendix 8 and Appendix 9 - Respondents' perceptions of accreditation bodies

Source: Based on data from the data questionnaire, compiled by the authors.