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Technology Integration of a Photonics System in China
中國光電子系統：科技集成應用

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Abstract

Photonics or Optoelectronics is one of the most pervasive and key enabling technologies of the 21st century touching every aspect of our lives.

Optoelectronics – The merger of optics and electronics is increasingly present in our everyday lives through familiar technology such as televisions, compact disc players, fiber optic communication systems, barcode scanners in the supermarket and mobile telephones, etc. However, this is the tip of the iceberg, as the technology expands into such fields as displays, transportation, medicine, environmental monitoring, computers and construction. Optoelectronics will be the all pervasive technology that continues the propulsion of progress in the new century that has been driven by electronics over the past 40 years.

China has put photonics as one of the major economic drivers and national key technology strategies in the last 5 years and has renewed her extra efforts in the new 11th Five Year Plan (2006 – 2010). Southern China especially in the Pearl River Delta (PRD) is now becoming the photonic manufacturing hub of the world with most of the top vendors having manufacturing facilities there. The local Chinese photonic companies are too developing fast from manufacturing components to sub-systems and onto the system level, and gaining in local market share. These companies have been carrying out contract manufacturing for other international vendors as well as producing their own brand of products.

With the growing local demand for a wide range of consumer or communication-related photonics products, these Chinese photonics companies are in pressing need to produce customized products with local characteristics in order to meet these demands. As a result, the ability to conduct technology integration from a conceptual design of a new product to the development of the product and hence take it to the market requires these firms to be able to innovate. The ability to innovate and the level of innovation will be an important competitive advantage for these local firms in differentiating themselves not only from home- grown competitors but more importantly from international photonics vendors.

It is a commonly acknowledged fact that these Chinese firms need to establish their own profile of Intellectual Property (IP) in the development of their product in order to be internationally competitive and increase in their own company value. The Chinese government is putting a lot of focus in developing the national IP profiles and is

encouraging local companies to make achievement in this strategic direction in the last few years.

With the above background, this research project touches on one of the key technological and industrial areas with enormous market potential – photonics, in the present day China. In addition, is the need for local firms to conduct technology integration in order to develop products with an innovation prospective. It is with these drivers that the research project is entitled "Technology Integration of a Photonics System in China".

This is the first of its type of research study known to be carried out in this field in Hong Kong and Mainland China covering the scope of:-

> "Technology Integration based on Systematic Innovation –"TRIZ", with a localized implementation model –"LEADS" which is developed for the first time and has taken into account the Chinese learning culture and applies to the emerging photonics industry in China. LEADS can also be extended to other areas of application and interests in China for further development"

The aspect of technology integration with an innovation prospective is explored through a well established and acknowledged technique for systematic innovation called TRIZ (a Russian acronym meaning "Theory of Inventive Problem Solving") which was established nearly 60 years ago in the former USSR by Genrich Saulovich Altshuller (1926-1998). The author of the thesis has conducted a review on a few methodologies and techniques of creativity but concluded that TRIZ is the only technique that can provide a structure and framework for systematic innovation with a set of tools, principles and parameter sets. It is because of this well proven and widely applied systematic innovation technique that TRIZ is the preferred choice for the technology integration study in this research study.

However, based on the past many years of experience by TRIZ users around the world, it is important to localize, customize and simplify the TRIZ deployment locally or specifically. Japan is a good example which has developed a local version of TRIZ called USIT in recent years.

As a result, this research study will discuss a newly-developed model, reported for the first time, called **LEADS** (**L**earn, **E**valuate, **A**dapt, **D**evelop, **and Specialize**) which is designed to implement TRIZ in China in various stages or phases.

The model has been discussed among many local industries and applied in real cases. The author believes that TRIZ will gradually become popular and applied in China as the country is moving into establishing local branded products with local design elements across a wide range of industries. Once the reported success and experience of applying TRIZ in Korea and Japan is shared and made well known in China over the next few years of the cultivation period, TRIZ will start to gather local support and application. However, the main important issue is to establish a local development model for TRIZ so that a systematic approach for applying the methodology can be referenced. The author will first discuss various initial hurdles in using TRIZ in China based on first hand experience. The various phases of the LEADS model will then be studied together with application to a real case example of a consumer optoelectronics-based product to conduct technology integration. The author has applied various Inventive Principles, Contradiction and Substance Field Model as a part of this investigation.

The Application Case Study presented in this thesis is an illustration of how the LEADS model can be applied for the adaptation of TRIZ in the local optoelectronics industry in order to generate an innovative product / system design. A systematic approach to innovation will not only generate new ideas faster and hence quicken the creation of potential new business opportunities to the local business, it also enhances the capability in design and acquisition of new knowledge that the design team may not have been deeply involved with or appreciated before.

In the Case Study herein, the electronic engineers assigned to this project were originally not familiar with IT techniques, e.g. various data compression and encryption techniques. However, after adapting TRIZ through the LEADS model, the project team engineers carried out work on the embedded version of the proprietary data compression format with real-time decode which was based on a micro-controller design within an electronic device. This system design requires the common users to first obtain the authentication via the internet before any decoding can take place. The whole project was able to be completed in just seven months, which is less than the original expected time of over ten months based on the team's past experience.

The LEADS model is designed to be an integrated core platform with framework and structure that generically facilitate the change of all the technology designers' culture from a "reference-based" behavior to an "analytical and problem solving based" behavior in Mainland China. However, such a change in design culture is also applicable in different industries and different "design" functions. Therefore, the

LEADS model is also suitable for all those in non-technological areas such as designers, strategy makers, operation model constructors or even government policy planners alike who can then make use of TRIZ efficiently and effectively in their corresponding design responsibilities.

Based on the local corporation in the case study of this thesis, there are two major achievements using TRIZ. The first achievement is that both the senior management and the design individual become much more "open minded" towards innovation. The second achievement of using the LEADS model is to equip the corporation and its staff so that they can become immediately available to bring an innovative idea into a practical product through a series manipulation of the TRIZ tools in a reduced time schedule, boldly, systematically and confidently.

With China already a member of the WTO, it is believed that local industries are and/or will be facing stronger competition from overseas. In order to remain competitive, a design professional can no longer simply focus on his or her own knowledge scope. An "open mindset" is the basic requirement of all designers. The request on efficiency and effectiveness in rolling out a design blue print has been the most important consideration of senior management in order to justify the use of company resources. On the other hand, it is also extremely important to give self confidence to a design team which is responsible for putting innovative design into real achievement.

The author's LEADS model was developed to adapt TRIZ locally which has already addressed the common cultural characteristics of the Chinese design professional.

Future extension of the project will then need to focus on trimming TRIZ appropriately to further address various characteristics among different industries and/or functions within corporations in China. This is the Phase IV and V of the author's LEADS model –"Develop" and "Specialize" respectively.

The company in the case study has applied the LEADS model with satisfaction and is prepared to extend the model to other product areas. The model has also received enthusiastic support from members of Guangzhou Optics and Optoelectronics Manufacturers Association in Guangzhou, China who are in various studying and implementation stages. In addition, support of the research work also came from Hong Kong Optoelectronics Association (HKOEA) and Hong Kong Electronic Packaging & Manufacturing Service Association (HKEPMSA).