

CREST10

A tapestry of stories about
the Malaysian journey in
Collaborative R&D
2012 - 2022



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FOREWORD

AN UNUSUAL TAPESTRY

A decade ago, CREST was set up as a neutral entity to effectively initiate a culture of collaborative research and development (R&D) in Malaysia by tapping on the resources and expertise of a network of Malaysian universities and E&E companies. Happily it has done more than that.

The idea behind CREST was to create an R&D center for the E&E industry – one that would work closely in a far-reaching way to build cross-sectoral relationships with different stakeholders and facilitate the movement of generated ideas to prototyping to measurable outputs that will benefit Malaysia in many ways.

This concept was mooted and discussed by leaders of leading multinational corporations (MNCs), and in 2012, the Government of Malaysia bought into the idea. CREST was later set up with an initial RM100 million government grant which leading multinational corporations then pledged to match, ringgit-for-ringgit. As a matter of fact, the companies pledged to see to it that the value of the outcomes produced would be at least seven times the ringgit spent.

The CREST's story is a story of a unique collaborative R&D journey in Malaysia.

From the Malaysian Government's standpoint: CREST is a powerful link to the E&E industry and an entity that works with Malaysia, for Malaysia, to support the well-being and growth of a dynamic E&E manufacturing sector that contributes to about 40% of Malaysia's total exports annually.

For Malaysian E&E companies: CREST represents a flexible platform through which they can achieve critical R&D goals, shape the workforce of the future and cultivate the development of a world-class manufacturing ecosystem.

For Malaysian universities: CREST delivers opportunities to undertake and participate in industry-driven R&D projects that deliver “real-world” rewards, including due recognition, published papers, intellectual property (IP) applications and patents. CREST has also facilitated innovative industry-relevant training programmes and projects for the benefit of high school students, university undergraduates and graduates to better prepare them for rewarding careers in the electrical and electronic (E&E) industry of the future.

So, CREST is a unique organisation because it represents different things to different parties and people.

10 years on, the organisation has stayed true to an intended course. However, along the journey, it has evolved (and is still evolving) to meet the changing needs of various stakeholders, including the Malaysian Government, government agencies, technology-driven MNCs, local listed companies (LLCs) and small-and-medium enterprises (SMEs) involved in high-tech manufacturing, as well as technopreneurs, inventors, researchers, graduates, undergraduates and students.

So, to mark its 10th anniversary, we decided to do something unusual.

In celebrating the spirit of collaboration, we decided to engage a group of CREST’s key benefactors and beneficiaries. We got them involved in the content of the CREST10 book.

Stepping aside from a “typical” non-fiction book narrative, we decided to present a kaleidoscope of viewpoints in journalistic style, much like a series of news features or magazine interview pieces. We portrayed personalities alongside content, while sharing a diversity of independent, yet complementary, viewpoints.

We thought this approach would produce a more interesting read. The CREST10 book project kicked off at the beginning of the endemic phase of the Covid-19 in Malaysia. We chose to collect the viewpoints of our collaborators through CREST10 VIDEO SESSIONS 2022, a series of online discussions covering key pre-set topics.

While hosting and moderating the sessions, I realised that we were “telling” the story by weaving a tapestry of CREST-related stories. Carefully laid out in the past, this tapestry stretches to the present and tracks the winds of change a little way afield...into possible futures.

So, here it is, in the form of the CREST10 book.

What we have here is the result of a collaborative effort. It speaks up about collaborative research in engineering, science and technology in Malaysia, by Malaysians, for the benefit of Malaysia.

For me, the last 10 years have flown by quickly. The journey has been an unconventional one, from its humble beginnings where we began with a single room and a handful of people to a twenty-six strong team a decade later.

These stories told by my “co-writers” capture the essence of our journey to date - the triumphs, successes, hardships and everything in between.

Producing this book and the video sessions have reminded me of fundamental things of great import. Most of all, I believe the results we show have exceeded expectations.

For that, I must credit and commend my co-writers:

- ***Datuk Seri Jebasingam Issace John***, the former CEO of the Northern Corridor Implementation Authority (NCIA);
- ***Prof. Emerita Datuk Dr. Asma Ismail***, President of the Academy of Sciences Malaysia;
- ***Mr. Cheah Hun Wah***, Co-Founder and Chief Technology Officer of Opstar Technology Berhad;
- ***Dato’ Cheok Lay Leng***, Co-Founder of Infinecs Systems Sdn Bhd;
- ***Dr. David Lacey***, Director, Advanced Development & Services, R&D of ams-OSRAM;
- ***Mr. Eric Chan Wai Phang***, Vice-President of IOTG (Internet of Things Group) Customer Engineering of Intel Corporation;
- ***Mr. K. Y. Goon***, Executive Chairman of TT Vision Holdings Berhad;
- ***Dr. Nayyar Hussain***, CEO and Founder of M3DICINE Pty Ltd
- ***Dato’ B.C. Ooi***, former Senior Vice President of Global Operations, Broadcom Inc;

- **Mr. Solomon Lorthu**, Vice-President & Managing Director of Penang Operations, and Interim Country Manager of Motorola Solutions;
- **Dr. Tan Ching Seong**, CEO of Terra Pheonix Group of Companies
- **Mr. T.K. Tan**, Managing Director of Clarion Malaysia Sdn Bhd; and
- **Prof. Dr. Zaidi Mohd Ripin**, Lecturer of Mechanical Engineering of Universiti Sains Malaysia (USM).

Thank You.

Jaffri Ibrahim

Chief Executive Officer, CREST
December 2022

EN. JAFFRI IBRAHIM

Chief Executive Officer, CREST

Jaffri is the founder CEO of Collaborative Research in Engineering, Science and Technology (CREST). He began his career as an entrepreneur that built an information service in Klang Valley in 1986. He joined Oracle Corporation Malaysia in 1990 as a consultant and started his own technology consulting business in 1994 focusing on the Oil & Gas industry. He later joined Arthur Andersen's Business Consulting division in 1998 and then the Technology Consulting and Technology Integration Services group at Cap Gemini, Ernst & Young in 2002.

Prior to joining CREST, he was Vice President of Business and Technology Advisory Division of Malaysia Debt Ventures (MDV) Bhd.

Jaffri obtained his B.Sc. from the University of Iowa, Iowa City, USA where he majored in Computer Science and minored in Business Studies.



A QUICK INTRODUCTION

On 18.4.2011, a group of E&E industry leaders made a presentation to Malaysia's Economic Council (EC), chaired by Dato' Sri Haji Mohammad Najib bin Tun Haji Razak, the 6th Prime Minister of Malaysia.

The title of the presentation was:

*“Accelerating R&D Growth in the Electrical
and Electronics Sector.
Can we take the curve at a higher speed?”*

The authors of the presentation were listed as: Intel, Advanced Micro Devices (AMD), Osram, Altera, Motorola, Agilent Technologies, Silterra, the Penang Skills Development Centre (PSDC), Universiti Sains Malaysia (USM, a Malaysian public university), Khazanah Nasional (a government-linked investment company) and the Northern Corridor Implementation Authority (NCIA), a regional development authority.

The presentation was facilitated by the Malaysian Investment Development Authority (MIDA) and sponsored by Tan Sri Nor Mohamed Yakcop, who was then serving as Malaysia's Minister of Finance (II).

14 months after that presentation, on 9.6.2012, a non-governmental organisation (NGO) and nonprofit organisation (NPO) was officially launched to drive “industry-driven collaborative research and development (R&D)” activities in Malaysia.

Its founders named it CREST, in reference to “Collaborative Research in Engineering, Science and Technology”.

CREST's launching was backed with a RM100 million government grant, and the E&E companies pledged to match that grant value, ringgit-for-ringgit, in the form of industry contributions.

Its founding members comprised the following multinational corporations (MNCs): Agilent, Altera, Avago, Intel, Motorola, National Instruments, Osram and Silterra. In 2012, the combined revenue of these companies was estimated to be RM25 billion and their total R&D expenditure was estimated to be RM1.4 billion.

From the beginning, CREST was "industry-driven". It took on targeted R&D projects with guidance, input, support and contributions from an industry-led Board of Directors.

"Collaborative R&D" means that CREST's R&D projects involve joint research work with leading Malaysian public universities. In the early stages, CREST collaborated with Universiti Sains Malaysia (USM), Universiti Malaya (UM), Universiti Teknologi Malaysia (UTM), Universiti Putra Malaysia (UPM) and Universiti Kebangsaan Malaysia (UKM), and subsequently included eighteen other private and foreign universities.

For the record, the key personalities who played a key role in CREST's inception in 2012 include:

- Mr. Jordan Plofsky, former Senior Vice-President and General Manager of Altera Penang;
- Dato' B.C. Ooi, former Senior Vice-President for Global Operations of Avago Technologies;
- Dr. David Lacey, Director, Advanced Development & Services, R&D of ams-OSRAM;
- Dr. Hari Narayanan, former Managing Director of Penang Operations, Motorola Solutions;
- Dato' Sofi Osman, formerly Managing Director of AMD, and Altera;
- Mr Atul Bharagawa, former Senior Director, Construction Projects and Environmental Health & Safety of Intel;
- Encik Hamdan Abdul Majeed, Managing Director of Think City (a subsidiary of Khazanah Nasional); and his team, especially Mr. K. Gopalan, former Senior Vice-President of Khazanah Koridor Utara, and Encik Aziz Kevin Lee, former Assistant Vice-President of Khazanah Koridor Utara;

- Datuk Redza Rafiq, former CE of NCIA; and En. Farid Wajidi, former Director of NCIA and his team, especially Mr. Cheang and BY Leong.

The other individuals who significantly contributed to the development of CREST subsequently are:

- Dato' Noha, former CEO of MIDA, and former Chairman of CREST
- Dato' Azman Mahmud, former CEO of MIDA and former Chairman of CREST;
- Dato' Boonler Somchit, former CEO of PSDC;
- Datuk Seri Jebasingam Issace John, former CE of NCIA;
- Mr. Chris Kelly, Vice President, Client Computing Group and Client Distributed Intelligence of Intel.

“NGO”, “NPO”, “industry-driven” and “collaborative R&D”: These are the words that defined, and continue to define, CREST’s unique DNA in Malaysia.

So, why did the government, E&E companies and universities join forces in R&D through CREST?

One answer is that there was a lot at stake in 2012. And, the stakes have risen to a higher level in 2022.

“Malaysia’s export value grew 26% to a record high of RM1.2 trillion in 2021 from a year earlier as the country’s December figure expanded 29.2% to RM123.8 billion, led by the sale of electrical and electronics products to major importers like China, the US and Singapore, according to the Department of Statistics Malaysia (DOSM) on 28.1.2022.”

The majority of Malaysians know that E&E MNCs employ thousands of personnel in Malaysia, rewarding them with good careers and employment benefits. These MNCs’ operations are supported by thousands of local listed companies (LLCs) and small-and medium enterprises (SMEs) which, in turn, employ thousands of other Malaysians.



- *“To survive and thrive in the age of open global competition and rapid technological advancements, the Malaysian E&E sector must constantly evolve and move upwards in the manufacturing value chain. Stagnation, intransigency and/or resting on laurels could prove to be fatal.”*

- Key takeaway from CREST Board of Directors

Meanwhile, the performance of other economic sectors in Malaysia (including the services, retail, hospitality and construction sectors) are highly dependent on the purchasing power of the E&E sector and its employees.

CREST is guided by a pro bono Board of Directors, the majority of whom are leaders in leading E&E MNCs in Malaysia. In the past 10 years, the insight, input and commitment of these “industry captains” have steered CREST to stay on-course with industry needs, local technological challenges and global market trends.

These “industry captains” have consistently stated and reiterated an important fact:

To survive and thrive in the age of open global competition and rapid technological advancements, the Malaysian E&E sector must constantly evolve and move upwards in the manufacturing value chain. Stagnation, intransigency and/or resting on laurels could prove to be fatal.

Meanwhile, other Asian countries have progressively stepped up their game in competing for high-tech, high-value manufacturing investments. Compared to Malaysia, many are now offering cheaper labour costs, more attractive investment incentives and very business-friendly government policies.

As pointed out by **Dr. David Lacey**, ams-OSRAM’s Director of Advanced Development Services, R&D: “We need to be paranoid. There are other parts of the world which are trying to eat our lunch. We need to compete and stay up to speed.”

Meanwhile, Malaysian E&E manufacturers (some of whom are celebrating their 50th year of operations here) are fully focused on manufacturing world-class products that meet the changing demands of a rapidly evolving global marketplace. Otherwise, they will inevitably lose market share and millions (if not billions) in revenue.

Mr. T.K. Tan, the Managing Director of Clarion Malaysia summed it up succinctly: “We are not competing against Myanmar or Vietnam for product market share. We are competing against Japan, Europe and the USA.”

Bottom-line:

Malaysia’s E&E sector must consistently sharpen one competitive edge to survive and thrive in today’s technology-driven world. That competitive edge is R&D.

For most Malaysian E&E companies, the goal of a R&D project is to create a new product, improve an existing product, introduce a new technology and/or a new industry segment.

If that new product, solution, technology or industry is developed in Malaysia, it can be “anchored” in Malaysia (for some time) for everyone’s benefit.

Moreover, the results of a successful Malaysian R&D project need not be exclusively applied in Malaysia. Potentially, Malaysian tech inventions, solutions and technologies can be applied anywhere, thereby opening up a world of markets and opportunities.

Hence, successful Malaysian R&D can lead towards fantastic long-term rewards, due recognition and improved income for the country, companies and the people.

In the tech world, the challenge is to innovate continuously. E&E companies know that they can generate more value if they continuously create new products, solutions, technologies or industry segments and commercialise these assets on time.

Through CREST, E&E companies in Malaysia channel suitable R&D projects to university researchers (who have the expertise, knowledge, resources and access to advanced research facilities) to get the job done.

To paraphrase **Prof. Dr. Zaidi Mohd. Ripin**, Lecturer of Mechanical Engineering at Universiti Sains Malaysia (USM): “As scientists, we would really like to see the knowledge, which people have gained from studying, being applied in projects that generate real value, in terms of supporting economic growth and boosting business competitiveness.”

Amongst CREST’s “greatest hits” in the past 10 years is its involvement in gallium nitride (GaN) research in Malaysia. The successful implementation of its “GaN-on-GaN” R&D project, involving technology transfer to Malaysia, has already paid good dividends.

Dr. Lacey: “OSRAM’s decision to invest in those technologies in Malaysia is at least partly driven by the fact that we knew that there was a valuable talent pool which we could develop and operate those processes. Other companies are also making decisions to invest here because Malaysia has the talent pool. So, let there be no doubt that this scenario is a direct result of the

programme and the availability of those skills. You do not need thousands (of GaN technology researchers), but you need a few hundred very skilled scientists. And, we have the first 80.”

On the flip of the coin, there are Malaysian inventors and technopreneurs who have come up with remarkable ideas, products, solutions and technologies.

In theory, an inventor or technopreneur can an easily reach out to the global market in today’s connected world to become rich and famous. The reality is that the majority of Malaysian inventors, scientists and researchers need proper funding, guidance, support and connections to successfully commercialise their hard work. There are many prudent procedures to follow and pitfalls to avoid.

This is where CREST has also stepped in to provide assistance and mentorship. In its 10-year history, CREST has served as an incubator for start-ups. In fact, CREST has also helped to convince foreign inventors to set up R&D and manufacturing partnerships in Malaysia.

When asked to comment on his experience in working with CREST, **Dr. Tan Ching Seong**, CEO of the Terra Phoenix Group of Companies said: “CREST’s personnel are clear on the processes and principles of research funding. I would say your level of professionalism is the highest that I have encountered at every level, from the clerical level to the executive level to the top management level when it comes to reviewing our projects. The second thing is: CREST actually focuses on patents and IP rights.”

Dr. Nayyar Hussain, the CEO and founder of M3DICINE Pty Ltd (Australia), invented an AI-enabled stethoscope and decided to collaborate with CREST to have his device manufactured in Malaysia. He said: “We were introduced Malaysia by a great mentor of mine, Professor Sinskey at Massachusetts Institute of Technology (MIT), USA. He knew that I had been travelling around the world looking for great partners. He said: Look, there is a really great ecosystem in Penang that you should explore. The necessary contacts were made. We flew up to Penang and we met with CREST. The rest is history.

Over the past 50 years, many success stories have been recorded in Malaysia’s E&E sector. In the past 10 years, CREST has helped to grow and nurture a more proactive and dynamic R&D culture in Malaysia’s E&E manufacturing ecosystem.

It seems only logical to assume that more and more Malaysians would be willing to take on careers in the E&E industry or becoming a technopreneur.

However, Malaysian academicians and industry leaders are concerned about the emerging talent pool for the future.

Touching on the topic of industry-related undergraduate training, **Prof. Emerita Datuk Dr. Asma Ismail**, the President of the Academy of Sciences Malaysia, said: “At the end of the day, we (still) need to know what exactly and how many of these undergraduates and in which area should we train them and how we should we train them. Even with the existence of neutral entities like CREST that can bring the universities together, especially for the E&E industry, there is still a need to address what is that exact need.

“Because, you know, the industry, being competitive, has got to change. And, when you change, the curriculum is not meeting the needs of the industry fast enough.”

Meanwhile, **Mr. Eric Chan**, the Vice-President and General Manager of IOTG Customer Engineering in Intel Malaysia, said: “Over time, there will be a crunch in the good talent pipeline and I think this is where we need to invest ahead. Most of us are doing leading edge design now, and we need a lot of creative talents to keep pace with knowledge-based industrial activities.

“So, I think CREST can take on a much broader scope (of talent development activities) to apply some of the best practices (in industry-relevant training) across the country.”

Therefore, Malaysia’s journey of Collaborative R&D must go on.

10 YEARS REPORT

Along a journey, it is prudent and refreshing to catch a breath and take stock of proceedings. On paper, 10 years may seem like a “long time”. On the other hand, if one is kept excited and busy, a decade can pass rather swiftly. In any case, CREST’s 10th anniversary provides an opportune moment to review the results achieved thus far.

Over the past 10 years, an organisation that started off as an initiator and facilitator of collaborative R&D projects in Malaysia has also:

- Nurtured the birth of new gallium nitride (GaN) epitaxy technology in Malaysia;
- Served as an incubator for 37 Malaysian tech start-ups with surprising potential;
- Convinced over 700 collaborators to forge Collaborative R&D and manufacturing links in Malaysia; and
- Coordinated more than 200 industry-driven talent development programmes for the benefit of more than 4,000 students from 188 schools; more than 9,000 undergraduates and graduates from more than 30 universities, 239 MSc/PhD holders and 5 technopreneurs.

So, the question is: ***“Has CREST been successful?”***

A 10-year report card may provide an answer in an easily digestible manner. As the saying goes: “the results speak for themselves.” And yet, there is so much more to the CREST story, to be related in the following pages.

CREST 2012 - 2022

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PROJECTS COMPLETED

RM269.5MPROJECTED BUSINESS VALUE
OF PROJECTS COMPLETED**161**PROJECTS
APPROVED**60**INTELLECTUAL
PROPERTY (IP)
APPLICATIONS FILED**RM28.2M
(35.8%)**VALUE OF
GOVERNMENT
GRANTS USED**RM50.6M
(64.2%)**VALUE OF
UNIVERSITY
AND INDUSTRY
CONTRIBUTIONS***12.0x**RETURN OF
INVESTMENT (ROI) FOR
EVERY RMI INVESTED
FOR R&D PROJECTS**112**MEMBERSHIP
(MNCS, LLCS, SMES
AND PUBLIC AND
PRIVATE UNIVERSITIES)

* (based on EPU's creativity index formula)

1

MALAYSIAN R&D?

Let's talk about CREST.



Watch video

An industry veteran and a Penangite, **DATO' OOI BOON CHYE** “zoom-ed” in to the first CREST10 VIDEO SESSION 2022 from California, wearing a disarming smile.

“I joined the Penang electronics industry in 1976. When I joined Intel, I was a newbie trying to figure out what is it we were trying to manufacture because semiconductor manufacturing was totally new to everyone in Malaysia.

“Initially, our focus was on manufacturing. Later, our focus moved to the product. How did it get introduced into the consumer environment as well as the corporate environment? And finally, we were able to engage with the R&D people who delivered these wonderful new technologies,” he said.

In the period 1980 – 2009, Dato’ Ooi found himself working around the world: in Barbados, Phoenix (USA), Albuquerque (USA), Portland (USA), Puerto Rico, Ireland and Silicon Valley, California (USA).

In 2009, he found his way home. “I was back in Singapore and Penang when I joined Avago Technologies as the Senior Vice-President for Global Operations. And, I was based in Singapore and Penang,” he said.

Landing back in Penang, Dato’ Ooi inevitably joined the “Local Captains of Industry” (Managing Directors and Vice-Presidents of MNCs) in Ministry of Finance (MoF), Malaysian Investment Development Authority (MIDA), Ministry of International Trade (MITI) and Penang State Government dialogues and forums.

“After the niceties we would be asked: Are you doing R&D? When are we going to do R&D? I was kind of intrigued by that.

“Back then, the MoF, MIDA, MITI and the Penang state government pretty much associated Penang E&E with factory operation, meaning low-level manual assembly repetitive work. And somehow, there was always a bigger buzz to move the conversation towards R&D and chip design.

“In the minds of the Malaysian senior government officials (then), we must move upwards to higher level skills, and hence, we would not need to hire so many foreign workers. Malaysians can achieve higher incomes.

DATO' OOI BOON CHYE

Former Senior Vice President of Global Operations, Broadcom Limited.



Dato' Ooi was responsible for managing worldwide manufacturing, outsourcing, procurement and logistics, planning and quality programs. He also served as Senior Vice President of Worldwide Operations and Business Process Reengineering at Xilinx Inc. since November 2003 until January 9, 2009.

Prior to that, Dato' Ooi has more than 25 years of experience at Intel Corp. and also served as Vice President of the Corporate Technology Group and Director of Operations. In 1986, Dato' Ooi moved to the United States, where he served in Intel as Assistant General Manager of logic components manufacturing, Director of Component Planning, and Plant Manager for A4/T11 in Chandler, Arizona.

Since 1990, he served as General Manager for worldwide systems manufacturing, with plants in Puerto Rico, Ireland, Washington, Malaysia and Oregon.

“The logic was not incorrect,” he noted.

“Now, a few of us had lived in the heart of Silicon Valley. We had a better comprehension of R&D. I kept telling people it is much more than putting up a building with a sign that says: research & development,” he added.

Nevertheless, the gentle prodding and continuous “reminders” from Malaysian government officials did hit home.

“A few of us gathered to ponder this question of how to initiate Penang E&E R&D. I will miss a few people by doing it from memory. There was Jordan (Plofsky) who played a very significant part. If I remember correctly, he was with Altera (Corporation) at that point in time.

“And, (Dato’ Dr. Mohd.) Sofi Osman (also from Altera), Mr. T.K. Tan (Clarion Malaysia) and Dr. David Lacey (ams-OSRAM). I may miss some of the other Managing Directors, from Intel as well as Motorola and so forth. All of them contributed to the effort,” Dato’ Ooi said.

Then, he said, the “captains” proceeded to anoint Mr. Plofsky as their representative to table collective proposals and recommendations to the Prime Minister of Malaysia.

“Jordan did a superb presentation in April 2011. He impressed Dato’ Sri Najib (enough for him) to allocate \$100 million in government funding for CREST to launch the Malaysian collaborative R&D venture,” Dato’ Ooi said, adding that: “I also need to make a special mention of Tan Sri Nor Yakcop (who was Minister of Finance II then). He was a very enthusiastic supporter.”

To underscore the “practicality” of the CREST concept, Dato’ Ooi carefully outlined the key initial ground rules:

- Selection of collaborative R&D projects based on substance and merit, involving “industry mentors” (from the MNCs);
- At least 50% funding of the total R&D project costs would come from the industrialists (“We did not ask the government to fund everything”);
- Choice of projects that could be completed in a timespan of 2 -3 years, and not 5 - 10 years, to show quick results and promote a sense of joint achievement;

- Patents generated would be owned by whomsoever contributed to the major portion of the work; and
- Involvement of engineers and researchers from local universities to grow a Malaysian pool of R&D talent (“It was not that we would just send people to do projects without getting any technical or educational credits”).

In summing up the initial objective of CREST, Dato’ Ooi said:

“The whole idea was small projects, training ground. We develop the engineers, give them fair credit, recognition and rewards for their good work. Hopefully, these engineers in the future will be ready to take on more complex R&D challenges.

“They would then take on stand-alone R&D projects, and eventually, all Penang-driven R&D lab projects. By the time I left the CREST board, this progression of things was well on its way.

“I would not say that we had absolute success or that we created megastars, but I think you have to start by having hundreds of small stars. So, I think that is where we are. CREST is in good shape going forward.”

Looking back before CREST was established, Dato’ Ooi said: “If the captains, as you call them, had not taken the initiative to nurture R&D growth in Malaysia, things could have been fine. The MNCs would have been happy to give us work in Penang and doing that work would be as far as our manufacturing accomplishments go.”

“However, I think our local engineers want to do more, and be more technically knowledgeable. And, they want to do original work, not just somebody else’s work. I have not found an engineer who turns down an offer to do something completely new and achieve something completely new.”

“So, we are encouraging our engineers to do more. In fact, we challenge them to go and get themselves challenged and not shy away from difficult engineering tasks.”

When asked if he saw any “improvements” in the Malaysian E&E ecosystem in 2022, Dato’ Ooi had this to say:

“I was actually in Penang recently. I must say that a tremendous amount of innovation has been monetised, in the form of SMEs who have gone public in

the Malaysian Stock Exchange. This would not have happened if they were just basically doing assembly work.”

“You have companies like Aemulus Corporation Sdn Bhd. I toured their factory, and their new factory is actually better than the Avago factories which were built 20 years ago.”

“Another example is Greatech Integration (M) Sdn Bhd: this little company is growing and in many areas that eventually will showcase it well in the fields of medical automation, solar power and batteries. I think I am seeing all of these (SME success stories) because we had taken that next step of not just doing manufacturing, but doing R&D. “

“There is also Vitrox Corporation Berhad and many others. They are testaments to the fact that all the things we started through CREST are getting Penang people to be well compensated. That is motivation.”

For **MR. T.K. TAN**, the Managing Director of Clarion Malaysia Sdn Bhd, the value and importance of R&D in Malaysia could not have been more “relevant” in 2020 and 2021:

“Over the last 2 years of the Covid-19 global pandemic, when parts were not available or difficult to source, we needed to be able to implement design changes to ensure that products could still go out of the door. “

“If we did not have a qualified and experienced R&D team, that would have been totally impossible to do. We could not afford to wait for instructions from headquarters when they were trying to take care of all the other subsidiaries in the world.”

“To be able to do everything under one roof helped us to stay alive. Local R&D was a survival tool during the Covid-19 crisis. Without it, most Malaysian manufacturing companies could have reached a dead end.”

A fervent believer and supporter of Malaysian R&D activities since the 1980s, Mr. Tan also quick to point out the following facts:

“If you cannot design a product based on local sourcing capabilities, you are simply not leveraging your cost-effectiveness in Malaysia.”

“Clarion Malaysia supports the needs of the global automotive industry. Our clients in the East and West have different requirements for components they



- *"If you cannot design a product based on local sourcing capabilities, you are simply not leveraging your cost-effectiveness in Malaysia."*

- Mr. T. K. Tan, the Managing Director of Clarion Malaysia Sdn. Bhd.

want to buy. So, unless you can adapt your product or design to meet different requirements, you cannot qualify to be a global supplier (for navigation, AV and information systems)."

Commenting on the origins of CREST in 2012, he said:

"There is a difference between buzzwords and walking the talk. Walking the talk requires investments in time, money and effort. Through CREST, the Malaysian E&E sector industrialists have been walking the talk."

"We mooted an idea. Then, we spent the last 10 years doing things in support of that idea."

Through the CREST platform, he said, a team of industrialists worked collaboratively with the government and academicians to initiate the right actions for mutual benefit.

"We may not be able to address global issues, but we can address issues in the E&E manufacturing ecosystem here."

"We have 50 years of manufacturing history in Penang. While I cannot speak on behalf of all the MNCs, I can speak for Clarion Malaysia. We are a multinational joint venture company with a 50-year track record. We are still operating here today."

"We are not competing against Myanmar or Vietnam. We are competing against Japan, Europe and the USA."

"We know the advantages that Malaysia offers. Think of these advantages as pieces of a jigsaw puzzle. We have all the pieces. We just have to piece them together to complete the picture."

"We have been working at this for 10 years because we believed in it."

"Let me put it in another way: to produce a world-class dish, you need the right ingredients and a good chef. In the context of collaborative R&D, CREST has shown us that it is possible for our local chefs to churn out world-class dishes using local materials in a local kitchen. And, that, is a success story that more people should hear about. The point is: we may not be the experts but we can be successful integrators."

Another key CREST result, according to him, is “new talent indoctrination” (but in a good sense and for good reasons).

“Through CREST, we have been reaching out to young people in Malaysian academic institutions. In effect, CREST’s activities are indoctrinating Malaysian students, undergraduates, graduates and researchers to think that they can go far in the field of industry-driven R&D.”

“If you wanted a job in the Malaysian manufacturing company 10 years ago, getting a job in production department was probably your best bet. Now, we are guiding a new generation of job seekers to choose more challenging and rewarding careers. They have the option of working in Penang while being able to challenge the world in terms of product design, innovation and R&D.

Joining our Clarion R&D team allows them to do that. All the MNC R&D teams here allow people to do that. Even Malaysian SMEs are also actively doing R&D today.”

“So, through CREST, we are encouraging a new generation to think smart, think forward and adapt to changes so that they can take charge soon. This process must begin when they are students, so that they can understand and adopt a positive and daring engineering mindset, like young engineers in the Western countries.”

The CREST Director also believes, rather strongly, in continuing and enhancing the process of sharing information, feedback and ideas with CREST’s academic partners:

“I think the Malaysian academicians need continuous input from CREST. CREST is basically honest to the core. Its pro bono Board Members know how things are moving day by day and hour by hour, in various E&E sub-sectors. We are not reading newspapers to tell them the news.”

“Instead, the pro bono Board Members talk about things as they see it, as well as the global and local challenges that they face. No dressing up and no holding back. So, CREST’s industry insights provide universities with a clear view of what is required.”

“For example, let us talk a little bit about the automotive industry. A car was mostly a mechanical device. Today, we are looking about software-defined vehicles or connected vehicles.”

MR. T. K. TAN

Managing Director, Clarion Malaysia Sdn. Bhd.

Mr. Tan Teong Khin joined Clarion (Malaysia) Sdn Bhd in 1989 as a Director and has been instrumental in the establishment of the R&D and the development of the local OEM Business. He was responsible for the conceptualisation and development of several new products using new technological methods.

As a Founder member of CREST, Mr. Tan has been participating and contributing to CREST's key events and strategy discussions, as follows:

- Delegated as an industry representative to Economic Planning Unit (EPU) on the Cluster Development Program.
- Recommended local entrepreneurs and technologists with high potential to CREST for collaboration.
- Participated actively in CREST's Symposiums in Puerto Rico, Ireland, Washington, Malaysia and Oregon.



“That means that every automotive component now requires serious software integration. So, E&E engineering (by itself) is no longer enough. We are talking about E&E, mechanical and software engineering projects and programmes that will involve international collaborations.”

“So, firstly, we need multilingual engineering personnel who can communicate and work effectively with people from different cultures using various languages as needed.”

“Secondly, we need more Malaysians who are knowledgeable in the field of hardware and software integration.”

“Thirdly, we need more R&D personnel who dare to take on the challenges of designing of world-class automotive products; products that offer user-friendliness, high performance, improved functionalities, competitive pricing and good durability.”

If CREST could help to ensure that Clarion Malaysia had enough talent and Collaborative R&D resources to tap on, he added, the company would continue to manufacture made-in-Malaysia automotive components that are globally competitive.

“We look forward to employing more young Malaysian engineers and R&D personnel and rewarding them with good career benefits. They will also be exposed to global challenges and be given opportunities to work with, and learn from, global leaders in automotive technology, electric vehicles, advanced battery technologies, cloud servers, mobile apps, embedded chips and embedded software.”

“If we manage to grow our global market share, our operations in Malaysia will also support the growth of more Malaysian SMEs and help to increase Malaysia’s export earnings.”

And that, according to Mr Tan, sums up the importance and relevance of CREST to the Malaysian E&E manufacturing ecosystem today.

“In a word, it was paranoia,” said **DR. DAVID LACEY**.

The Director of Advanced Development & Services, R&D, ams-OSRAM, was responding, half-whimsically, to a question as to why Penang’s “Captains of Industry” had agreed to form and participate in CREST.

DR. DAVID LACEY

*Director of Advanced Development & Services,
R&D, ams OSRAM Group*

Dr. Lacey has extensive experience in the semiconductor industry, including over 13 years of experience holding different leadership roles in Osram Opto Semiconductors, from Material Development Manager in Osram USA, to Engineering Manager and General Manager in Osram Technologies Malaysia, to his current role as the R&D Director since 2008. Prior to Osram, he was with the Cambridge Display Technology, Cambridge, UK.

Dr David Lacey was one of the exco committee members involved in the earlier phase of conceptualisation and inception of CREST since March 2012. Until today he has consistently devoted substantial time, support and contribution to CREST's activities and establishment since its inception and its formal official launch in June 2012. Dr Lacey obtained his DPhil in Chemistry/Materials from the University of Sussex, UK.



“I have been based in Malaysia for some years. MNCs are quite ruthless, at times, in their choice of locations. I was interested to keep Malaysia regionally competitive for MNC investments now that R&D capability was becoming an important criteria. When we compared Malaysia to other locations like Korea, Singapore, Hong Kong, and Taiwan, we noticed that this R&D dimension of the chain was somehow disjointed in Malaysia.”

“There were good universities, but there were some gaps between the universities and industry. And, when we looked at the other places, we saw that they had ways of building better relationships with universities. So, part of the reason for forming CREST was to establish a body that could build that linkage to the universities. I think we’ve been successful in that,” he said at the Zoom session, joining the session from the United Kingdom.

Dr. Lacey noted that Malaysian universities were initially wary of working with the MNCs.

“They had not had a great deal of interaction with industry over the years. So, CREST has been very successful in building trust. CREST spoke to the universities from a neutral standpoint to build good working relationships. So, it worked.”

“Now we have demonstrated our ability to transfer research work that can lead towards product development and manufacturing. From the ruthless MNC perspective, Malaysia can compete effectively in the region,” he said.

He pointed out that CREST had, in fact, established a “network of trust.”

“The universities trust CREST. You treat them even-handedly and provide them with information on trends and technical directions. As such, the universities believe in CREST’s direction and they duly focused efforts to achieve goals specified in the projects or topics which CREST brought to the table. This is unique.”

“CREST has also established trust with companies. CREST has proved that it is not here to squeeze money and never deliver. This gives us the confidence to commit time, money, and resources to activities and projects. This is also unique.”

“Unique implies something which is not easily replicated. It has taken CREST 10 years to build and enhance its relationships,” he added.

Dr. Lacey noted CREST's neutrality as an asset.

"Everybody understands that CREST operates neutrally. It does not have a hidden agenda, and therefore, it has established itself as a go-to place for the industry. If you want to do R&D together with universities, involve CREST. Because that is the most efficient way to get it done," Dr. Lacey added.

"So again, going back to the start: we need to be paranoid. There are other parts of the world that are trying to eat our lunch. We need to compete and stay up to speed and CREST is helping us to compete," he said.

Going further, he spoke candidly about the impact of Collaborative R&D in Malaysia.

"It is the ability to apply the technology to support manufacturing so that manufacturing can operate self-sufficiently. In other words, we no longer depend on headquarters to teach us what to do, as long as headquarters says identify this market or go in this direction."

"The ability to design, develop and manufacture products on our own is proven. We can do that now. That is a great step forward, and it has only happened in the last 10 years," he said.

Dr. Lacey pointed out some industries were going in the direction of single nanometre node and high-precision engineering. But, there is another dimension.

"When we talk about gallium nitride (GaN) today, we are talking about bringing GaN together with the complementary metal-oxide semiconductor (CMOS) silicon, which is already established in Malaysia. For me, that is the next great opportunity. So, this heterogeneous integration of the different technologies is the next step."

"This is the idea of combining technologies. It is not easy but Malaysia is in a good position because we now have both the digital and analog silicon technologies plus the compound semiconductors. If you can combine those, you can create new products and expand into new markets."

"We have proven that it is possible with the LED and optoelectronics business. CREST can do the same for other businesses now," he said. GaN technology leads the way into Chapter 2, wherein some of "CREST's Greatest Hits (2012 – 2022)" are presented.

2

CREST'S GREATEST HITS In Collaborative R&D.



Watch video

2012 – 2022

91

R&D projects successfully completed

60

Intellectual property (IP) applications filed.

These are the stories of its “greatest hits” to date,
as told by the key players and beneficiaries.

GaN – A CRYSTAL THAT FORETELLS THE FUTURE?

A CREST & ams-OSRAM STORY

Like silicon, gallium nitride (GaN) is a crystalline semiconductor material. Specifically, GaN is a compound semiconductor. As such, semiconductors are indispensable in the design and production of the integrated circuits (ICs) that serve as the brains for all “smart devices”, including smartphones, computers, audio-visual and augmented reality (AR) devices as well as planes, trains and automobiles. Today, ICs can also be found in washing machines, air-conditioning systems and refrigerators, and a humble LED light bulb housing.

Since the 1960s, silicon has served as the crystal of choice for manufacturing ICs. However, there is a need to develop and exploit a “better” semiconductor in order to make more capable ICs for tomorrow’s world.

Enter GaN: It offers more stable functionality in higher temperature environments and higher power applications.

GaN’s better qualities may also spawn power conversion electronics, which are smaller and more powerful, more powerful radio frequency (RF) transmitters, better wireless and telecommunications systems, as well as higher definition yet energy-efficient optoelectronic (LED) displays.

That said, GaN is still expensive when compared to silicon in 2022. Its application in consumer electronics products is still limited. It will take some time and R&D work to anoint GaN as a rational successor to silicon in the world of high-tech manufacturing.

The good news is: Through CREST’s involvement in a transcontinental United States-Malaysia GaN epitaxy programme, Malaysia has gained a firm foothold in the field of GaN R&D.

As of 2022, the potential of GaN technologies has not been fully realised yet. However, it has already convinced a number of multi-national companies to invest in compound semiconductor manufacturing operations to pursue the potential of GaN technologies.

JAFFRI IBRAHIM (CREST):

This program has positioned CREST at the forefront of GaN research for producing high-power light-emitting diodes (LEDs), the next generation of power electronics, radio frequency products, micro LCD displays, ultraviolet LEDs and laser lighting. I invite Dr. David Lacey to share some insights on CREST's GaN programme and its benefits.

DR. DAVID LACEY (ams-OSRAM):

The programme started because we identified a gap in the chain of technologies leading to LEDs in 2012.

Malaysia was strong in the LED assembly business and the LED fabrication business.

However, there was there was no activity in Malaysia when it came to epitaxy (the crystal growth technology for GaN).

Together with CREST, we put together a consortium to get us up to speed. And, I think we have been quite successful with that. Looking ahead, we now see power opportunities for GaN, and most semiconductor companies are interested in establishing a position in GaN technology. Therefore, the work that we have done has positioned Malaysia and its universities in a great place to participate.

JAFFRI:

When we started this discussion in 2012, we had a small handful of GaN researchers in Malaysia. Today we have around 80 GaN researchers. Is this something of an advantage for Malaysia?

DR. LACEY:

It definitely is. ams-OSRAM's decision to invest in those technologies in Malaysia is partly driven by the fact that we knew that there was valuable talent available to develop and operate processes. So, having those skills

is absolutely critical to some of the decisions that large companies are making about where to invest in GaN technologies.

We are not the only ones. Other companies are also deciding to invest here in GaN technologies because there is a (GaN research) talent pool.

No doubt, this is a direct result of the programme and the availability of those skills. You do not need thousands of very skilled scientists. You need a few hundred of them, and we already have the first 80.

JAFFRI:

We also have two world-class GaN laboratories that we established in Malaysia. Can you give us a bit of background about those labs?

DR. LACEY :

We set about in this programme to build up lab capabilities. It became apparent that there was already something in the works at the Universiti Malaya (UM), and so we were able to bring things together.

The key thing that we did, which I would say was opportunistic, was to work together with the US team from the University of California, Santa Barbara (UCSB). When Professor Shuji Nakamura was visiting Malaysia in 2013, we took a chance to discuss if we could collaborate with him on GaN epitaxy and the potential form of such a collaboration.*

“Shuji, are
you willing to
transfer,
your technology?”

** Datuk Yoon Chon Leong, a LED industry veteran who had worked for Hewlett-Packard/Agilent in Penang and Silicon Valley (USA), is a CREST Board Member. In 2013, he was the Malaysian who took a risk and asked this question to Professor Nakamura in Kuala Lumpur.*

It was not a simple technology transfer. It was a complex scheme to get both facilities (USM and UM) up to speed, and students and academics up to speed with the latest GaN epitaxy technologies. So that, results could be generated in California or in Malaysia, using similarly configured reactors and similarly trained scientists. That approach has been a great success.

So, we have gone from a situation where six years ago, there were no active GaN epitaxy reactors in Malaysia to a situation wherein we have two universities with labs and reactors doing world-class research work in Malaysia. It is a great success for CREST and the team.

JAFFRI :

A few background details: The two Malaysian universities with epitaxy labs are UM in Kuala Lumpur and Universiti Sains Malaysia (USM) in Penang.

The person behind UCSB's GaN research is Professor Shuji Nakamura. He is an inventor of the blue LED. During our discussions in 2014, he won a Nobel Prize for Physics (together with Professor Emeritus Isamu Azaki and Professor Hiroshi Amano for the invention of efficient blue light-emitting diodes, which has enabled bright and energy-saving white light sources).

So, we were very fortunate to forge a working collaboration with a Nobel Prize winner to establish two world-class GaN labs in Malaysia. This GaN programme gives Malaysia the advantage of developing our own IPs and patents so that we become more of a player in GaN research. Do you agree, Dr. Lacey?

DR. LACEY :

To be successful, we need to have access to the whole value chain of GaN technology. The historical separations between the crystal growth, the fabrication and the packaging are disappearing.

It is necessary to know how to handle wafers in a packaging environment and it is equally necessary to understand epitaxy in the fabrication environment. So, these things must come together to maximise efficiency and success. Therefore, ensuring that we have the skills in the entire value chain of this technology, and building an ecosystem around it, is critical to the success.

As I said at the start, we identified a gap. Malaysia did not have the crystal growth work. Together with CREST, we have filled that gap. From a technological building block or chain perspective, we now have all the technologies here in Malaysia, which all companies can benefit from if they want to manufacture or develop GaN products or research GaN technologies.

REDUCING WIND NOISE FOR BETTER TWO-WAY CRISIS COMMUNICATIONS: A MOTOROLA SOLUTIONS & USM STORY

Through CREST, Motorola Solutions Malaysia collaborated with Universiti Sains Malaysia (USM), a leading Malaysian public university based in Penang, to innovate a local R&D solution for a global problem in wind noise performance. Traditional wind porting design requires large geometries but as mission-critical devices get smaller, implementing a good wind noise performance becomes a challenge.

MR. SOLOMON ARULANANDAM LORTHU, Vice-President & Managing Director of Penang Operations, and Interim Country Manager, Motorola Solutions Malaysia, outlined it as such:

“Imagine you are a first responder working in a harsh environment where the wind speed exceeds 100 km/h. In such conditions, the clarity of your speech and the information you are trying to convey could be severely compromised and clouded by the volume of wind noise.”

“Motorola Solutions has become a global leader because we were able to overcome this issue by designing two-way radio solutions in a way that would mitigate this problem.”

“Technology trends are ever-evolving, and consumer appetites are also ever-evolving. Instead of large and clunky two-way radios, customer demand has now led us to produce smaller and slimmer devices.”

“To retain our new solutions’ audio integrity performance, we faced a big challenge because the new device footprints were smaller. As such, Motorola Solutions had to resolve the wind noise problem (all over again) but in a different, unique and creative way. This was the problem statement that we brought over to Professor Zaidi.”



MR. SOLOMON LORTHU

Vice President & Managing Director of Penang Operations, and Interim Country Manager, Motorola Solutions Malaysia Sdn. Bhd.

Solomon Lorthu was appointed to his current position on 1 January, 2018. He has assumed overall responsibility for the company's operations at its Penang site, including Supply Chain, R&D and Global Solutions & Services Center.

Solomon continues to lead the R&D organisation in Malaysia, the largest R&D setup for Motorola Solutions globally. Solomon has over 21 years of experience with Motorola Solutions and has held various key leadership positions within the company during his tenure.



PROF. DR. ZAIDI MOHD RIPIN

Professor, School of Mechanical Engineering and Head of TheVibrationLab, Universiti Sains Malaysia

Professor Dr. Zaidi Mohd Ripin holds a Bachelor of Engineering (B.Eng) degree in Mechanical-Marine Technology from the Universiti Teknologi Malaysia in 1989, a Master of Science (M.Sc) degree in Tribology in Machine Design and a Doctor of Philosophy (Ph.D) in Mechanical Engineering (Vibration analysis) in 1991 and 1996 from the University of Leeds, United Kingdom.

He was previously a Dean of the School of Mechanical Engineering and School of Aerospace Engineering (2007 – 2015) and is currently a Professor at the School of Mechanical Engineering and Head of TheVibrationLab, Universiti Sains Malaysia (USM).

PROFESSOR ZAIDI MOHD RIPIN is a Lecturer of Mechanical Engineering at USM. He manages the university's Vibration Laboratory. The USM team, he said, approached this R&D project with trepidation.

"This was our first collaborative R&D project with Motorola Solutions. We know that the industry can be demanding when it comes to meeting customers' expectations. We knew we had to meet high expectations. Moreover, we were not used to tackling this kind of multi-physics problem."

"Then, about midway through the research work, we discovered that there was something to be learned about the generation of vortices at the edge of two-way radios that could influence the amount of wind noise being generated."

"And, to our surprise, the cut-off frequency of 3kHz really affected the intelligibility of the speech transmitted through a two-way radio system. This was compounded with other variables such as the wind noise not coming from just one direction but many directions."

"Finally, by understanding the physics of it, we could use our newly acquired knowledge to re-position the microphone at a more optimal location. That led to the reduction of the noise related to wind vortices," he said."

As a result of this collaborative project, the Motorola Solutions-USM R&D team became more proficient in using advanced simulation tools that were set up in the USM's Vibration Lab. This high-tech equipment, which includes a "wind tunnel" test machine, is still installed in the laboratory for use in other CREST collaborative projects which may involve USM and other CREST members in the future.

Most importantly, a United States (US) patent was filed in 2014 and granted in 2018. Mr. Solomon described it as "the icing on the cake." "So, through this engagement, a US patent was filed back in 2014 entitled - Slim Tunnel Wind Port for Communication Devices. It incorporates a slim geometry as part of the patent coverage," he added.

According to Mr. Solomon, Motorola Solutions has incorporated the "sound and robust solution" generated from this collaborative R&D project in a new platform of products for the global market.

"Right now, this solution actually goes into many portfolios that we have, and it ships in large volumes to our customer base worldwide," he said, adding that what goes around also comes around: "Our first responders in Malaysia are also amongst the beneficiaries of this solution."




Apart from the commercial value generated, Mr. Solomon said, this project also motivated Motorola Solutions to invest and set up its own wind tunnel testing facility in Penang. “I am happy to say that we have established a Center of Excellence in Audio Engineering in Penang, in service of our global design centers across the world,” he added.

As for Professor Zaidi, he has since become a serial collaborator with CREST, who is now undaunted by the prospects of taking on challenges presented by industrial clients based in Malaysia.

“In bringing about such collaborations, CREST has created a new research culture whereby scientists must now engage with industries to solve industrial problems. I always emphasize that research must be in context. If you lose that context, research will not be as meaningful and impactful as it should be.”

“As scientists, we would really like to see the knowledge that people gain from studying being put into practice to generate value in terms of economic benefits and business competitiveness,” he said.

“I am very proud of what our students have done and our capability to provide global solutions. So, I am thrilled to have worked with Motorola Solutions. They have great minds there, and it gives me confidence that Malaysia has a great future with talented engineers,” he added. “Of course, some of them are former USM students.”



**“BETTER EYES” FOR MACHINES THAT SEE
MICRO-CRACKS IN SOLAR WAFERS:
THE TT VISION & USM STORY**

MR. K.Y. GOON, the Executive Chairman of TT Vision Holdings Berhad, signed Memorandum of Agreements (MoAs) with USM and CREST to make more powerful artificial intelligence-driven (AI-driven) “eyes” for machines. His machines specialise in detecting micro-cracks in wafers used in solar energy harvesting panels.

As of 2022, Mr. Goon has an install-base of more than 50 machines worldwide. “We have sold quite a number of machines in Malaysia and the US. We also have systems running in Korea, China and the Philippines.”

“This project is interesting because it utilises novel imaging technologies to reveal hidden defects. Instead of relying on the visible spectrum of light, we use AI-driven infra-red technology to detect defects underneath the material.”

“I must say that we have seen a tremendous take-off, in terms of commercialisation, after we completed the development work,” he said.

At the core of the machines, he said, is a “vision system embedded with AI-driven image processing.”

“We call them algorithms. We have been developing AI know-how for many years. We have been working with USM for many years on certain AI technologies that they are very good at.”

“Through the co-development of AI algorithms, we have managed to boost the performance of photoluminescence image detection,” Mr. Goon said. “This year alone, we have sold a number of systems that incorporate the results of our collaborative R&D work with USM. We are confident that this will continue to gain market acceptance.”

According to Mr. Goon, the R&D project also yielded four Ph.D. graduates, two of whom are now working with TT Vision.

“I think producing quality post-graduate students is important, but retaining them in Malaysia is perhaps more important.”

"This is one of the reasons why we wanted to build a relationship with local universities in Malaysia. My engineers have presented papers on our co-development project in Europe. I have presented papers in China, as did Professor Mohd Zaid Abdullah from USM."

"As I see it, a key objective for universities is to produce good graduates for industries. Another is to publish quality academic papers to enhance the Malaysian universities," he said.

"I am proud to say that we have been collaborating with universities, particularly USM, for a long time. This is the way to go for both the industry and the universities."

"CREST has been instrumental in facilitating Collaborative R&D projects and serving as a catalyst for industry-academia collaborations."

"Sometimes, it is not as simple as bringing the industry and the academia together, but also serving as a bridge for funding and matching the right parties together. CREST has played its role well," Mr. Goon said.

When asked about future plans, he answered: "We are into our third or fourth project with USM. We are currently working with USM on another project that is a continuation of a project under the CREST banner."

MR. GOON KOON YIN

*CEO & Executive Director,
TT Vision Holdings Berhad*



Mr. K. Y. Goon is responsible for the Group's corporate development, raising venture capital funds and grants, marketing and business development activities, talents development, industry-academia collaboration and R&D. He was instrumental in bringing venture capital investment from an institutional investor. He also spearheaded an R&D collaboration with Universiti Sains Malaysia to develop infrared imaging and artificial intelligence software.

He has more than 20 years of experience in semiconductors, electronic manufacturing services and the robotic and solar industry. He has vast knowledge in the design and development of vision inspection algorithms, robotic systems, artificial intelligence, machine software, motion control, calibration, metrology and automation system.



**A 3-MUSKETEER START-UP WHICH NOW
DESIGNS ICs FOR THE GLOBAL MARKET:
THE OPPSTAR & CREST STORY**

MR. CHEAH HUN WAH, the Co-Founder and Chief Technology Officer of Oppstar Technology Berhad, appeared to be one of the most appreciative collaborators for this book.

“We were a CREST incubatee. We started in the rented CREST collaboration area. Over the years, we received great collaborative support and mentorship from CREST. I truly appreciate and recognise CREST’s efforts, especially in the Penang semiconductor industry,” he said.

Cheah founded Oppstar with his colleagues Ng Meng Thai (CEO) and Tan Chun Chiat (COO) in 2014.

“We went through a lot in the early days because we started off as a 3-musketeer company with our own money. Oppstar is an integrated circuit (IC) design technology company. We were able to leverage CREST’s emphasis on collaborations and research between universities, CREST, and the private sectors, to bring about much innovation and productivity.”

“For a technology design house, a strong foundation is important. IC design is an art because there are so many aspects to a design and so many key intellectual property (IP) designs to be integrated. Besides developing individual Intellectual Properties (IPs) designs, we also have to bring everything together successfully to make it work as a whole. That is why it’s called an integrated circuit.”

“There is no way you can cut corners to achieve certain end results. I would say that our journey has been very exciting. It takes a lot of hard work to bring and build a solid team across the many design functions of designing a chip. We will continue to steer the company into a capable and competitive global technology company, instead of just being contended to be a *kampung* champion,” he explained.

“Today, we are a company with 200 IC designers. It’s still a relatively small IC design company compared with both regional and global companies, where

some can even reach tens of thousands of design engineers. We will continue to cultivate more IC design knowledge workers/engineers for the company as we grow faster and faster, which is very much in sync with Malaysia's drive to become a knowledge nation.

Meanwhile, internally we also continue to cultivate and develop our existing talent pool into their individual next level, while looking out for new talents."

However, as Mr. Cheah noted, the company's customer base is already pretty substantial across Malaysia and global regions.

"We serve customers in Malaysia, North America, Europe and East Asia. We managed to secure several design wins in South-East Asia; and for Industry 4.0 applications worldwide. Our track record shows that we have successfully worked together with renowned MNCs in several turnkey projects," he said.

"Along the way, we have scored quite a number of design wins. We filed multiple IP patents registered with the US Patent Office and patent offices across other continents as well," he added.

According to Mr. Cheah, Oppstar has also ventured boldly into new fields.

"We have ventured into the design and integration of various application-specific ICs and systems-on-a-chip (ASIC/SoCs), field-programmable gate arrays (FPGA), radio frequency (RF) components and sensors."

"In recent years, we have developed our own artificial intelligence (AI) algorithms, focusing on the neuron networks protocol. We have an AI subsidiary that focuses on product development. So, we have expanded our scope beyond functional designing to focus on both the analogue and digital domains," he said.

And, he saved the good news for last:

"I am pleased to announce that we are now in the process of becoming a *Berhad* company (a Malaysian public limited company). This will be another major milestone we will mark soon, and I look forward to more excitement ahead."

MR. CHEAH HUN WAH

Executive Director & Chief Technology Officer,
Oppstar Technology Berhad

He is one of the co-founders of Oppstar Technology, a regional premier IC design centre headquartered in Penang, Malaysia.

Mr. Cheah is also the CEO of Airis Lab Technology, a leading Malaysian AI IC chip company focusing on leveraging Artificial Intelligence algorithms in chip design. He led a strong team of key technologists to successfully tape-out Malaysia's first Neuron Network Classification Engine IC chip through the TSMC fab process foundry back in 2019.

He has 25 years of experience in the industry, and his key strength lies in VLSI ASIC, SOC, FPGA IC design and the backend advanced FinFET design. Hun Wah also engaged in and completed over 200+ IC chip tape-outs in his career.



THE AUSTRALIAN INVENTOR WHO BROUGHT HIS AI-DRIVEN STETHOSCOPE PROJECT TO PENANG: THE M3DICINE, CLARION MALAYSIA & CREST STORY



In 2015, DR. NAYYAR HUSSAIN, the CEO and Founder of M3DICINE Pty Ltd (Australia), was on an urgent mission. Having invented an artificial intelligence-enabled (AI-enabled) stethoscope, he travelled around the world to find a suitable location to manufacture his device for the global market.

“We travelled to China, Taiwan, Korea and other places. We were introduced to the ecosystem in Malaysia by a great mentor of mine, Professor (Anthony J.) Sinskey of the Massachusetts Institute of Technology (MIT).”

“Professor Sinskey knew that I had been travelling to look for great partners. And, when we met up in Kuala Lumpur, he said - Look, there is a really great ecosystem in Penang that you should explore. We made the necessary contacts, flew up to Penang, and met with CREST. The rest is history as we ended up selecting Malaysia as our country of manufacture,” he said.

Dr. Nayyar cited the following reasons for choosing Penang and Malaysia:

- A location in closer proximity to Australia;
- No language barrier issues;
- The history of high-tech manufacturing in Penang, backed by the existence of MNCs with long manufacturing histories;
- An impressive local manufacturing eco-system; and
- CREST’s immediate response to his queries, including an introduction to his soon-to-be partner in R&D and manufacturing: Mr. T.K. Tan of Clarion Malaysia.

“There were also introductions to the Ministry of Health, universities and medical schools. So, this was music to our ears, in the sense that we have this fantastic ecosystem wherein within a stone’s throw away, we were able to access key opinion leaders from across those partnerships as well.”

"In other countries, you have the challenges of language and culture. Here, it was very easy for us to slide into working and establishing a great relationship with our partners," he said.

As far as CREST's collaborative approach was concerned, Dr. Nayyar said: "It surprised me. We genuinely value the contribution because CREST introduced us to Clarion Malaysia, our contract manufacturer, and several key partners that were critical for us."

"In 2015, we were prototyping. We were in the very early days, so we gained a lot of valuable feedback, advice and discussions from several partners from the Ministry of Health, public and private health institutes and universities. The feedback helped shape the journey that we subsequently took."

The invention that Dr. Nayyar brought to Malaysia is called "Stethee Pro." He described it as "the world's first AI-enabled stethoscope" and "a medical-grade device that fits in the palm of a hand."

"Medical diagnoses using traditional stethoscopes may be subjective: four doctors may have four different opinions if they listen individually to someone's heart and lung sounds. This subjectivity may be attributed to different doctors' different hearing abilities and/or interpretation of sounds."

"Stethee Pro removes human subjectivity because it is powerful and intelligent. In simple terms: it hears better and reports accurate data."

"You only have to put Stethee Pro on your chest to records your heart and lung sounds. The device then transmits data to a connected mobile device and/or to the cloud for easy access and analysis. With your permission, the heart and lung data can be shared, viewed and analysed by doctors and specialists anywhere in the world."

"You do not need medical training to use Stethee Pro, so the patients themselves can use it. Of course, it may be used easily and safely by doctors and healthcare professionals.

It may be used by teachers to quickly and accurately screen students in schools during a pandemic or it may be used by a heart patient on vacation on a remote tropical island.



“In summary, this AI-driven stethoscope opens up new frontiers for the world of advanced telemedicine. It defines what we discuss in the Fourth Industrial Revolution concerning the Internet of Things (IoT) and smart devices. So this tool really democratizes medicine,” Dr. Nayyar said.

To date, he added, M3DICINE has acquired approvals from the USA’s renowned Food and Drug Administration (FDA) and Malaysia’s Medical Device Authority (MDA).

“The FDA is the gold standard. It is very stringent for the country approval process that validates the hardware, the manufacturing, the hardware, the software and the algorithms.

So, I am proud to say that through our relationship with Clarion Malaysia, we were able to come out with a product that has met the world’s highest regulatory approvals for medical devices. We have received not only one approval but two approvals from the FDA.”

“Moreover, we also have the (Malaysian) MDA’s approval as well. It is wonderful for the MDA to approve this device for use within Malaysia. Adopting this new technology will empower healthcare professionals to improve the efficiency and quality of healthcare for all Malaysians. Bringing a product such as this into the country’s health ecosystem will put Malaysia at the forefront globally,” he added.

Elaborating on working with CREST, Dr. Nayyar said:

“Well, it has been an action-packed, fast-paced, opportunity-filled partnership.

The relationship with CREST has been really a catalyst for M3dicine. We were a start-up, and it helped accelerate us to reach a stage where we could reach out quickly. With initial manufacturing available, we could take units out for testing in the US and then on for the US FDA clearance.”

“Establishing manufacturing outside of Australia was a big step forward, but CREST helped to make that a very safe, great and warm kind of experience as well. We felt like we became part of the Penang culture.”

“And, that is why we are very committed to working with Malaysia, not only in manufacturing but also in R&D work for M3DICINE’s next products. With CREST, it is all there under one umbrella.”

Dr. Nayyar’s parting words were: “At M3DICINE, we are committed towards enhancing the relationship with CREST. We have created this international collaborative consortium called Medical Device AI Labs (MDAI). MDAI is bringing together universities, hospitals and everyone around the world to share a vision of a future where AI can provide deep insights into the medical fields.”

“We want to bring CREST into discussions with MDAI to begin clinical trials and to do more research into algorithms in Malaysia. And, hopefully, the R&D work for our next products will be carried out in Penang with Clarion Malaysia. So we’re looking forward to a long relationship and presence in Penang and Malaysia.”

DR NAYYAR HUSSAIN

*CEO and Head of Product Design,
M3DICINE PTY. LTD.*

In 2015, Dr. Nayyar invented Stethee Pro, the world's first AI enabled wireless stethoscope. Stethee Pro is the first device of its kind that has obtained US FDA clearance for its machine learning respiratory rate algorithms as well as cardiac systole and diastole durations.

He has a computer science and industrial design background and is a medical doctor with interests in emergency and occupational medicine. He studied at the University of Queensland Australia, Trinity College and MIT. Dr. Nayyar Hussain holds several international patents on medical device hardware, software, and UI UX design.

He has worked with CREST and medical device manufacturers in Malaysia to establish world-class device manufacturing for use in healthcare systems worldwide. Dr. Hussain is passionate about collaboration as a spark for creativity.



3

TALENT DEVELOPMENT

Getting more
Malaysians ready to
ride the crests of a
knowledge-driven era.



Watch video

In the “tech world”, a challenge or problem will inevitably raise a pertinent question. A tech company’s scientific approach to finding a correct and suitable answer to that question is usually called R&D.

For this reason, successful R&D always requires the right people or talents. Someone needs to ask the right question (or questions), and tech companies needs the right people to find a practical answer.

In Malaysia, public and private universities strive to provide the best possible education to their tech-oriented students.

However, when these students graduate, they may find that what they learnt do not always match to the “real world’s” needs of tech employers. To be fair, this is not a situation that is unique to Malaysia. It also exists in other countries, and some countries have developed innovative and workable solutions.

With its strong industry-university network forged through Collaborative R&D projects, CREST has always been in a unique position in getting young Malaysians ready for the knowledge-driven industrial era.

As mentioned earlier, CREST has coordinated more than 200 industry-driven talent development programmes from 2012 to 2022.

The beneficiaries of these programmes encompass more than 4,000 students from 188 schools; more than 9,000 undergraduates and graduates from more than 30 universities, 238 MSc/Ph.D. students and 5 technopreneurs.

So, has CREST done enough?

PROF. EMERITA DATUK DR. ASMA ISMAIL is the President of the Academy of Sciences Malaysia*. She has also served on CREST's Board of Directors.

"We knew we wanted to become a high-tech nation by 2030. When we want to achieve that vision, it has to be powered by science, technology and innovation (STI). Therefore, we wanted more Malaysian industries to become more science & technology (S&T) based and innovative, using home-grown technologies. Local researchers should preferably develop these home-grown technologies."

"That is where we wanted to go. but we faced an innovation chasm, where we saw the lack of collaboration between academia and industry. If we continue on this trajectory, there will not be much improvement in the state of our industries. The vision of becoming a high-tech nation may not be there," she said.

"We have the industry asking for real-world solutions, but the universities are doing blue sky research. Where do we actually meet?," she asked.

Moreover, Prof. Datuk Asma noted that the number of science, technology, engineering and mathematics (STEM) students in Malaysia is decreasing.

"Let me put it this way: you are trying to move deep tech and STI-based industries, but the number of STEM students in the country is decreasing. So, who will be able to operate all these industries of the future? It is imperative that we encourage, motivate and to inspire students to get back on track for science, technology and innovation (STI)."

"We needed someone, a trusted and neutral entity with the mandate, resources and manpower to actually coordinate and create a collaborative research network meant for demand-driven R&D and a market-driven delivery system. And, this is how we formulated the concept of i-Connect," she added.

The i-Connect is an industry-led collaborative network set up by Malaysia's Ministry of Science, Technology and Innovation (MOSTI) and the Academy of Sciences Malaysia.

"The CREST-like model we envisioned connects academia and industry," Prof. Datuk Dr. Asma said. "Through this connection, the universities could learn about the needs of the industry. Having learnt, the universities would, hopefully, adjust curriculums so that we can meet industry needs."

Through the “2u2i” programme, a Malaysian academic programme that promotes on-campus and off-campus learning, she said, universities may now ensure that undergraduates who are pursuing a four-year course of study could spend at least two years of study in an industry environment to the extent that has been allowed by the Ministry of Higher Education and the Malaysian Qualification Agency (MQA).

However, Prof. Datuk Dr. Asma noted that Malaysia’s government and academicians still needed to know more about “exact” industry needs. “At the end of the day, we (still) need to know how many undergraduates and in which area we should train them and how we should train them. Even with the neutral entities like CREST that bring the universities together, especially for the E&E industry, there is still a requirement to address the industry’s exact needs.”

“Because, you know, the industry, being competitive, has got to change. And, when you change, the curriculum is not meeting the needs of the industry fast enough. So therefore, there must be other ways”.

“Through collaboration, the industry is able to give training. Such training can happen after students graduate. However, if it is possible for the training to be provided while students are doing the undergraduate work, they will be industry-ready upon graduation.”

“And so, this is the aim of the game. Once we have done something like this, we will be able to create a talent hub that will satisfy not only the needs of our local industries, but also the needs of the global industries. Hopefully, with the change in mindset and the need for curriculum change, we will produce more graduates who will be able to fulfill the needs of the industry,” she added.

Challenges aside, she congratulated CREST on marking its 10th anniversary.

“What CREST has done in terms of Collaborative R&D is not just (based on) the big i-Connect concept. It also involves SMEs, and this has opened the eyes of the researchers and helped them to become more entrepreneurially minded. This perspective is essential to propel the industry to the next level.”

“This is a knowledge-based era. We also want to talk about the Masters and the Ph.D.-level talents because they are the ones who will create the new patents or solutions when they work with the industry. And, (who will) also use new and disruptive technology to ensure that our deep tech industries are ready to compete in the global market.”

“So, I think the training elements for the undergraduate curriculum is one thing and the R&D collaboration that CREST 2.0 is now doing is another. You actually inculcate a research culture that is industry-led.”

“Things become clearer when you review results. I can see that amongst CREST’s achievements is the fact that you have helped to train more than 9,000 Malaysians at undergraduate, Masters and Ph.D. levels.”

“These 9,000 graduates are now different because they know what the E&E industry actually needs. If we create more of such talent, they can help the industry to blossom,” she said.

From Prof. Datuk Asma’s standpoint, there is no reason why CREST should be limited to the E&E industry:

“The CREST concept is based on a neutral entity bringing together people, industry and academia to work on areas that will make industries more competitive. For example, the financial technology (fintech), health or halal industries, or any industry we need to move the country towards in the future. We are also leaning towards artificial intelligence or AI big time, and AI cuts across many industries.”

“We now know that industry-led collaborations usually lead to higher output, a higher commercialisation rate with talent development that is probably more relevant to the global market. So, congratulations, CREST. You know you can move any other industry, but deep tech is something that the country needs if we want to become a high-tech nation by 2030.”

She summed up CREST’s performance as follows:

“As far as E&E is concerned, the achievement is fantastic, with a commercialisation success rate of 27%. Even if our research universities are the top-anking universities in the world, they would not be able to commercialise up to 27% of their R&D projects. With industry-led collaboration, the (R&D) success rate has increased.”

PROF. EMERITA DATUK DR. ASMA ISMAIL

President, Academy of Sciences Malaysia

Prof. Emerita Datuk Dr. Asma Ismail, FASc. is a woman of many firsts. Besides being the first female Vice-Chancellor of Universiti Sains Islam Malaysia (USIM) and Universiti Sains Malaysia (USM), she is also the country's first female Director-General of Higher Education, first female President of Academy of Sciences Malaysia and the first female to be Chairperson of the Malaysian Qualifications Agency (MQA). Currently, she is the Ibn Sina Chair for Medicine at the International Islamic University Malaysia.



Her research impact includes attaining 16 commercialized worldwide patents and, the rapid diagnostic test for typhoid called TYPHIDOT, which was advocated by WHO. She had won numerous awards and recognitions for her achievements at the National and International levels. She has shared her knowledge via more than 400 invited talks and more than 50 keynotes at national and global levels.

** The Academy of Sciences Malaysia (ASM) is a Malaysian Government-linked corporation that was established under the Academy of Sciences Act 1994. Its objective is the pursuit, encouragement and maintenance of excellence in the fields of science, engineering and technology (SET) in order to promote the advancement of the art and practice of SET for the development of the nation and the benefit of mankind.*

*** From Wikipedia:*

Deep technology (deep tech) or hard tech is a classification of organisation or more typically, start-up company, with the expressed objective of providing technology solutions based on substantial scientific or engineering challenges. They present challenges requiring lengthy research and development, and large capital investment before commercialisation. Their primary risk is technical risk, while market risk is often significantly lower due to the clear potential value of the solution to society.

DATUK SERI JEBASINGAM ISSACE JOHN was the Chief Executive of the Northern Corridor Implementation Authority (NCIA*) from March 2019 to February 2022. He witnessed CREST's "humble beginnings" in 2012. A decade later, his opening words were:

"I must say that CREST is a catalyst for Malaysia's technology ecosystem development. CREST should always have in mind (the fact) that you are the hub for technology and ecosystem development, and we work together with the industry and academia to achieve this."

He noted Malaysia's "E&E needs to grow a collaborative R&D culture not only to support high-tech commercialisation projects in the existing manufacturing ecosystem but also to support and nurture future talent development. In this context, market-driven R&D and talent development are crucial."

"From our experience, we noted a big gap between what the industry needs and what our institutions of higher learning are providing. So, I think this is the biggest challenge in talent development, particularly in the northern region (of Peninsular Malaysia). The northern region is the nation's technology hub, where more than 50 percent of its E&E products are produced. The mismatch between talent supply and talent demand needs to be addressed on an urgent basis."

"The clustering of industries has been driving the growth of the region. So if we are not able to address this issue of talent and the needs of the industry, I think we are going to have a severe problem in the future," he said.

Citing the German "Meister" training programme, Datuk Seri Jebasingam proposed for CREST to champion a possible solution in collaboration with the Northern Corridor Implementation Authority.

"This is a classic example where the industry does the training and the academia or universities provide supporting qualifications and certifications. I think this is something that the industries in the northern region should work on together with the universities. Students can learn on the job and at the same time, they can get their final certifications by the universities, modelled after the German Meister program."

"Why must we keep this in mind? We must look into the needs of the SMEs and LLCs while we look at the needs of MNCs. We need to improve the entire supply chain and value chain in the technology arena. I believe CREST has an important role to play here so that we can achieve the integration that we are

DATUK SERI JEBASINGAM ISSACE JOHN

*former Chief Executive, Northern Corridor
Implementation Authority (NCIA*)*

Datuk Seri Jebasingam Issace John received his BSc. (Honours) degree in Housing, Building and Planning; the MSc. (Town Planning) degree from University of Science, Malaysia (USM); and the MSc. (Development Economics) degree from the University of Wales, Swansea, United Kingdom (UK). In 2016, he was awarded the Honorary Degree, Doctor of Laws (LLD) by Swansea University, UK for spurring industry-academia collaboration.



From 2019 until February 2022, Datuk Seri Issace helmed the Northern Corridor Implementation Authority (NCIA) as the Chief Executive, advancing the Northern Corridor Economic Region (NCER) as a viable destination for investment and development. He crafted the NCER Strategic Development Plan 2021–2025 (NCER SDP 2021–2025) on the basis of achieving a more equitable distribution of wealth in Malaysia through a balanced regional development.

His pivotal role in effecting policies and implementation of high-impact key projects revolutionised the infrastructural landscape of the northern region, thus accelerating the socioeconomic development in NCER.

talking about, particularly in creating an avenue for local SMEs to grow. This will also help to encourage fresh start-ups in the E&E sector.”

“If not, we will lose out to our neighbours who are moving very fast, such as Indonesia, Vietnam and Thailand. We are going to lose out if we do not address this issue of talent in a positive way,” he said.

“When you look at our universities, we have this broad-based engineering talent supply from the academia. What is important is the upskilling and training that needs to be done simultaneously. Upscaling and training in scripting and coding, cloud computing, software integration, IoT and gateway protocols are key towards this end.”

“This is where CREST can play a critical role. We should be looking into the engineering talent demands of the industry. This would include software engineers, design engineers, network engineers, front end developers and programmers. This is what the industry needs and we need to focus on these needs,” he added.

From Datuk Seri Jebasingam’s viewpoint, CREST’s decision to also focus on talent development programmes in schools was prudent.

“Interest in science and engineering is going down. We really need to have a strong base in schools. You have started a successful youth program, which will instill interest in E&E technology among young Malaysians.”

“CREST has, to date, engaged more than 4,000 students in 188 schools. So, I think this is something you need to expand. We need to think of more ways and means to create and generate more interest for science, technology, engineering and mathematics in schools.”

“Let us take, for example, robotics. It is an interesting field of study to capture and focus interest. It is a good place to start getting students interested in science and technology. So, let us focus on starting more R&D journeys in schools. And then, we go to the industry and the rest of the world.”

At the beginning of his session, Datuk Seri Jebasingam requested an opportunity to talk about CREST’s GaN programme.

“The GaN project was conceptualised to develop and train experts on epitaxy (the growth of GaN crystals) in Malaysia for the LED industry. CREST achieved the objective to develop and train local experts, on epitaxy GOG for LED and to

equip Malaysians with capabilities to carry out R&D programmes on the GaN technology and eventually produce and commercialise Malaysian-made LED.”

“This led to the filing of 7 IPs and the training of about 80 GaN experts in Malaysia. Consequently, there is a committed investment amounting to RM5 billion to date and we created nearly 10,000 jobs.

“This is a significant achievement in terms of value and contribution to the industry. As we celebrate CREST’s first 10 years, we should view the GaN project, a collaboration with the Northern Corridor Implementatation Authority (NCIA), as a classic example of successful Collaborative R&D in Malaysia. It is a great success story for CREST, the Malaysian Government, the industry and the universities.”

In short, this GaN on GaN project has proven to be an attractive proposition to catalyse the Northern Corridor Economic Region (NCER) as a world-class economic region and technology hub.

** The NCIA was established by the Malaysian Government in 2007 to oversee socioeconomic growth in the Northern Corridor Economic Region (NCER). The NCER is one of the regions identified under the 9th Malaysia Plan to promote balanced and equitable national economic development. It encompasses 4 states in Peninsular Malaysia: Perlis, Kedah, Penang and Perak. As of 2018, the NCER covered a land area of 32,404 sq. km, with a population of 6.8 million. In 2018, the GDP contribution of the NCER was projected to be RM215 billion (at 2015 constant price) or 15.8% of Malaysia’s national GDP. The NCER economy is projected to be RM300 billion GDP by 2025.*

MR. ERIC CHAN WAI PHANG spoke passionately about “investing ahead to excite young students.”

As Vice-President of Internet of Things Group (IOTG) Customer Engineering, Intel Corporation, he has actively supported CREST’s talent development programmes for Malaysian schools and universities for nine years.

“The talent pipeline is important because it will ultimately drive future innovation and productivity in Malaysia, more so for the high-tech industry. It is highly critical for us to invest ahead and invest more to excite young students so that more of them will choose to pursue science, technology, engineering and mathematics-oriented (STEM-oriented) education programmes in schools and universities”

“Huge opportunities are awaiting successful STEM-based graduates. MNC demand for such graduates is high across the world, especially in the E&E sector. Our growth will be limited if we are unable to hire enough engineers or technical talents to drive innovation in leading-edge hardware and software design.”

“This is the fundamental motivation for many MNCs and SMEs to partner with CREST and other government agencies to invest in talent development in this country. Every country is investing in its own high-tech industries, and rightly so because the pay is very rewarding for knowledge workers. The jobs are highly challenging but fulfilling.”

“I think Malaysia needs to adopt more of the best practices (as implemented) in other countries, as needed, and customise (such) programmes to suit our local requirements better. This includes endeavours to specifically fund programmes to develop sufficient engineering and technical talent to meet the demands of the industry,” he said.

In 2021, Malaysia enjoyed a “bumper year” in terms of industrial investment in the country. Intel announced a USD7 billion investment into Malaysia to grow its presence.

“Right now, we have a bit of a talent shortage. Every country is sourcing for talent. And what the pandemic has taught us is that, hey, some of this talent could be sourced from anywhere (in a connected world). And, you know, we have a lot of companies who could hire in Malaysia or from somewhere else.”

MR. ERIC CHAN WAI PHANG

Vice President of Intel and General Manager of Network & Edge Solutions Group (IOTG) Customer Engineering.

He leads a global customer engineering team with the charter to deliver product collateral, reference designs, platform solutions and technical support to enable customers and ecosystem partners to accelerate their designs into production. He is also the NEX Malaysia site leader focusing on talent development and strategic business alignment.

Eric is very active in collaborating with local ecosystem partners including government agencies like MIDA, MDEC, MIMOS and CREST. He was instrumental in enabling the set-up of the IoT Datacenter in CREST by influencing the industry partners. Often, he is invited as a keynote speaker and panel member on topics related to IoT and Smart Cities.



“Therefore, I think it is essential for Malaysia to provide the right incentives for Malaysian students to get into and stay with STEM. We need more suitable graduates to meet local demand, either in MNCs or SMEs.”

“We may also have to figure out if there are opportunities for Malaysia to source for talent overseas, maybe get more talent to come in and to support our high-tech growth,” Mr. Chan said.

“There are many interesting and creative policies in talent development that are being implemented in other countries. If we can reach out and understand some of these policies better, we can see if we can customise the policies for our country,” he continued.

He explained that MNCs and SMEs in Malaysia were fully aware that there could be “a crunch of good talent” at some point in time.

“We knew we needed to invest ahead and Intel has been doing so. We are reaching out to secondary schools and universities in Malaysia. We are invested in partnership programmes with CREST through projects such as TheGreatLab, Industry-University Challenge and National Hackathons in Malaysia,” he said.

The point is, he said, there could be a sizeable pool of future talent for high-tech manufacturing companies to tap if more Malaysian students could be “influenced to stay with STEM.”

“A sizeable pool of fresh talent emerges every year. The question is: Are they industry-ready? Many companies, including Intel, have great graduate and internship programmes offering the same incentives.”

“Moreover, we also have post-graduate programmes. We allow our employees to pursue Masters’ degrees while they are working. Our post-graduate programmes are not just aimed at retaining talent. It is also about developing talent.”

“Today, most leading MNCs in Penang, such as Intel, are involved in leading-edge design. We need talents who are knowledgeable, creative and innovative. We need our people to stay in touch with new developments in global technology,” he said.

As talent development is concerned, Mr. Chan said, CREST should widen the scope in 3 key areas:

- Shaping more progressive and holistic talent sourcing policies in Malaysia:
“CREST has connections with universities, industries and its peers worldwide. Other countries have implemented interesting and creative talent policies. Perhaps CREST can study, understand and support more progressive and holistic talent development and management policies in Malaysia while bearing in mind both local needs and global challenges?”
- Expanding the scope of industry-pioneered school and university talent development programmes throughout the country:
“CREST can apply some of these best practices (from Malaysia and overseas) which prepare students for high-tech employment. We can start at the secondary school level and follow up with the universities. If more students participate in exciting industry-led STEM-oriented programmes in school, they will be prone to pursue the relevant degrees in universities. And, by the time they come on-board, they will be ready for the industry.”
- Promoting better and broader post-graduate learning support for the existing high-tech industry workforce:

“Again, I think CREST can project a much broader view of industry needs and the importance of retaining and cultivating talent in Malaysia’s E&E workforce. Promoting and enhancing the best industry practices (in talent development) across the country is crucial.

As I said, many MNCs in Malaysia are involved in leading-edge technologies. We need our people to learn continuously and be knowledgeable if we expect them to be creative and innovative.”

MR. SOLOMON ARULANANDAM LORTHU believes that CREST must remain the “fulcrum” for scalable models of industry-relevant talent development programmes in Malaysia.

He further emphasized his statement with the following three reasons:

“CREST has a deep and intimate knowledge of technology trends in Malaysia’s very dynamic industrial landscape. It has also established a trusted network amongst many industry captains and serves as a fantastic go-between, or partner, to the academia in Malaysia.”

“CREST has also developed sustainable learning platforms that are both industry-relevant and well-implemented. This is what earmarks CREST amongst the many agencies that Motorola Solutions has worked with or is currently working with,” he said.

Summing up, the Vice-President & Managing Director of Penang Operations for Motorola Solutions Malaysia said:

“CREST has a fantastic value proposition that I am really excited about. A clear case in example would be ***TheGreatLab by CREST***, a collaborative industry-academia programme aimed to cultivate and nurture industry-relevant talents in Malaysia. The programme has resulted in many successful collaborations, and we still see the fruits of its labor today.”

As such, he added, it may not be necessary to “reinvent the wheel.”

“With its partners and the support of the Government, CREST should look at how it can stretch its current (talent development) model and scale it up for a wider outreach across the country. This effort will benefit the larger community of industries in Malaysia, as well as fledgling SMEs.”

“CREST can work with the academia to jointly grow and develop the talent pipeline for the country while providing increased access to research-based collaborations amongst the universities, start-ups, SMEs and established MNCs. This approach will help Malaysia to build a larger, stronger footprint in the technology world.”

“However, for this to happen with any modicum of success, CREST has to remain as the fulcrum of this scalable model where it continues to leverage its strength in understanding the ever-evolving technology trends as well as current and future industry needs.”



TheGreatLab

Where Greater Solutions
Are Created.



** TheGreatLab (TGL) is CREST's collaborative industry-academia programme that aims to seed, nurture and grow industry-relevant talents (potential R&D engineers of all ages, postgraduate researchers and technopreneurs) in Malaysia. TGL offers industry-relevant training programmes and methodologies to high school and tertiary education institutions students in programmes that are delivered as part of education curriculums or open training programs.*

“Why would we want to reinvent the wheel? Instead, we should leverage the cycles of learning and experience that CREST has successfully garnered over the last 10 years. Let CREST continue to act as a catalyst in lifting the talent development objectives to greater heights and at a faster pace,” he said.

For Malaysians students, Mr. Solomon had three pieces of advice to offer:

1. *Make the right choice and choose science, technology, engineering and mathematics (STEM).*
2. *Work hard and work smart.*
3. *Be committed to continuous learning.*

“It is always a great opportunity to build the foundations for where the world is going technologically. Look at Malaysia: this country is well positioned to be in the midst of anything and everything happening in the technology world.”

“We have had a significant presence for the last 50 years, and as we speak, the industry continues to grow its footprint. So, to Malaysian students out there: Make a great choice, choose STEM and take advantage of the opportunities within Malaysia which are varied, broad, wide, and more importantly, current.

“It is a great time to be in the STEM environment. All you have to do is work hard and also work smart because there is no substituting one for the other in STEM.”

“What comes together with that, I would hope, is an aptitude for continuous learning because technology is always changing. So, having that aptitude and accommodation for continuous learning is certainly a great attribute to have.”

“You should continuously evolve as a talent in this environment over the years, as you transition from the student world to the industry world. You have to develop the passion and enthusiasm for what you do.”

“The one thing that will carry you through, for a long time, basically comes down to one word: energy. The energy you bring to the proceedings and the work that you do as you contribute to your organisation,” he said.

TheGreatLab's programs encompass:

- “TheGreatLab Youth Programme” for high school students;
- “TheGreatLab Industry-Relevant Talent Programme” for university undergraduates and postgraduates; and
- “TheGreatLab Groom Domain Experts Programme” for academia and industry professionals

The rationale for CREST’s involvement in talent development is simple: It has to play a pivotal role in nurturing and developing a new generation of tech professionals and technopreneurs if it wants R&D in Malaysia to scale new heights.

Leveraging strong industry, academia and government linkages, CREST strives to inculcate an innovative mindset amongst students from when they are young while simultaneously steering the curricula of the institutes of higher learning to be aligned with industry needs.

For Malaysia to remain competitive, its education systems must evolve to become agile enough to motivate more Malaysians to learn continuously, adapt to new trends and innovate in the fields of STEM.

CREST’s industry-driven talent development programmes have as much to do with future industry success as future industry survival.

Malaysia must have the right people with the right knowledge, skills and mindset to stay competitive and relevant. Ultimately, they are the ones who will determine the country’s future place and space in an increasingly competitive and connected world.



4

CREST'S
Unfinished business.



Watch video

2012 – 2022

Over the past 10 years, CREST has facilitated the approval of Malaysian Government grants for:

161 COLLABORATIVE R&D PROJECTS

which are scrutinised by its Board of Directors to ensure industry relevance.

The total value of these 161 projects is projected to be


RM205.4 MILLION,

with a 36% contribution from the Federal Government and a 64% contribution from E&E companies and universities.

While 91 projects have been successfully completed and 60 IPs have been filed, a number of the CREST-approved projects are

STILL ON-GOING.

This chapter outlines 3 interesting ones with great potential.



**BACKING UP HEALTHCARE
PROFESSIONALS WITH AN INTELLIGENT
PATIENT TRANSFER SYSTEM:
A FREEDOM MEDICAL
INTERNATIONAL & USM STORY**

People are “getting bigger,” said **PROFESSOR ZAIDI MOHD RIPIN**, a Lecturer of Mechanical Engineering at Universiti Sains Malaysia (USM).

Hence, the lifting and movement of immobilised patients in hospitals have become more of a pain in the back for healthcare professionals.

To alleviate the problem, he said, a USM research team was working on a Collaborative R&D project with Freedom Med International (FMI) to develop an “Intelligent Patient Transfer System” (IPTS).

“I do not know if most people are fully aware of the challenges of patient transfers. It involves a lot of heavy lifting to safely position and re-position patients. This kind of work represents one of the biggest risks in the nursing profession as related to musculoskeletal disorders, generally described as back pain.”

“This is exacerbated by the fact that people are getting bigger as we progress. So, FMI has approached us and CREST with a project to develop a device that can help to mechanise and automate the transfer of patients. The objective of this IPTS is to minimise the physical efforts required for moving patients,” he said,

Prof. Zaidi explained that FMI originated in Australia and the company had set up a manufacturing plant in China.

On 15 January 2019, Jaffri Ibrahim from CREST met up with Ismail Cajee, Founder of FMI and Tan Sri Dr. Noor Hisham Abdullah, the Director-General of the Malaysian Ministry of Health (MOH). Tan Sri Dr. Noor Hisham suggested that FMI to set up an office and an R&D centre in Penang to upgrade its products by leveraging on developments in the Internet of Things (IoT), artificial intelligence (AI) and other state-of-the-art technologies.

Ismail took the advice and visited Penang with his son, Yusuf. He subsequently moved, with his family from Brisbane, to set up a Malaysian company called FMI Sdn Bhd in Penang. Through CREST, FMI also established a Collaborative R&D partnership with USM.

“We came in as a research partner to validate the design of the IPTS and to clinically prove its benefits,” Prof. Zaidi said. “This project is unique, and I am quite fortunate to be part of the whole process. Working with FMI brings us into the reality, the industrial perspective of the whole project.”

“Since our collaboration will affect their business and business direction, FMI sets the objectives and the timelines. We focus on the science, technology and engineering aspects of the work while instilling academic values in this R&D project,” he added.

As of May 2022, the project has reached the prototyping stage, and according to Prof. Zaidi, clinical trials will commence in Q4 2022.

“We are now in an exhilarating stage. We have been given an opportunity to transform hospitals into what we call hospitals of the future. A hospital of the future is where machines and robots would assist medical professionals to transfer patients.”

“We are also looking at developing other machines as a spin-off from the IPTS project. When we look at the literature and the products available in the market, we find room to move into several other areas. Hopefully, we can work together further with FMI because they have good access to the market and can assist us in developing more products using the same technology,” he said.

FMI has spoken to CREST about possibilities to design and manufacture exoskeletons and deploy new materials to produce different types of intelligent machines to support care workers in hospitals and care homes.

Prof. Zaidi said the FMI-USM collaboration on the IPTS could open new doors of opportunity for Malaysia.

“The solutions we will produce are local, but the problem is global. The global market is huge, and that’s why I am so excited about doing this kind of research.”

“There are not that many research projects in Malaysia that may potentially generate a global impact. I do wish for Malaysia to become a centre for patient transport technology. Hopefully, our work on the IPTS could serve as a nucleus to develop this industrial sub-sector for us,” he added.

Sharing his feedback about working with CREST and industrialists, Prof. Zaidi said:

“There are many advantages to working with CREST, and I will focus on two.

“The first is research context. We want to do research that is impactful to the world. Such is the transient nature of our lives on this earth that whatever we do, we hope it benefits people. Coupling with the industry is important because it gives research work a meaningful perspective and scope. It connects the research work to the next level, which is the global market. So, CREST’s strength lies in connecting university research to the real-world market.”

“The second advantage is the scientific discipline instilled when working with industry partners. These considerations translate into professionalism. Researchers must deliver on their promises, and these commitments keep researchers on their toes.”

“More importantly, scientific discipline ensures that results are commercialised on time and to cost. And, we know that the successful commercialisation favours researchers in many positive ways.”

“So, I have learnt from working with CREST that researchers need to be both good and practical in their work. As such, I really cherish these kinds of collaborative R&D experiences,” he said.

USING LIGHT TO SPEED UP 5G CONNECTIVITY: THE TERRA PHOENIX & CREST STORY

The technology was not commercially viable 10 years ago. Today, **DR. TAN CHING SEONG**, the Group CEO of the Terra Phoenix Group of Companies, is smiling as he thinks global and looks at a huge market.

“Our R&D project title is Hybrid Visible Light Communication in the Wireless System for Location-based Services. To simplify, we are prototyping a communications system that allows users to access the Internet at 5G speed, using light as a medium. This technology is existent. Today, we are focusing on the commercialisation of various potential applications in the global marketplace.”

“10 years ago, such a system was not commercially viable because there was no 5G requirement. 5 years ago, our mobile data requirement was about 5 megabits per second. Today, we use smartphones with a data demand of 30 megabits per second or higher.”

“As the world moves towards 5G mobile telecommunications, there will be higher data demand. So far, only China, Korea and a handful of other countries have managed to install and run 5G systems because of high investment costs and the inherent complications related to 5G infrastructure.”

“Unfortunately, 5G is still not affordable for most countries, including ours. So, the more cost-effective alternative is to use light to push more data at high-speed rates. Visible light is everywhere and it is freely available,” he explained.

To date, Terra Phoenix has secured two agreements with CREST to fund its research work on the commercialisation of its hybrid “li-fi” system. The name is derived from “wi-fi,” a marketing term that has proven to be more memorable than “IEEE 802.11b direct sequence wireless connection standard”.

“We combined a hybrid system in order to complement 5G. It may be installed within indoor environments, such as basement carparks, museums or hotels to enable fast and safe data transmissions using only visible light, and not a 5G millimetre wave.”

“Our system provides cost-effective installations. Moreover, light can potentially provide a data speed that is 1,000 times faster radio frequency,” he said.

According to Dr. Tan, Terra Phoenix has been talking to potential clients globally, not just in Malaysia alone.

“We have been talking to hotels, exhibition centres and museums. International 5-star hotel chains have expressed interest and they have been coming back to us. They are waiting for us to launch our first products.”

“Meanwhile, we have reached the final stage of project completion. I am pleased to report that we have seen two breakthroughs that were beyond our expectations,” he said.

The first breakthrough, Dr. Tan said, was the development of a hybrid li-fi hotspot in which multiple users may tap one light source for data, just like a typical wi-fi hotspot system.

“Secondly, we managed to penetrate through a few patents that will allow us to file our own patents. We had acquired a patent early in this project, and there are now three more patents to file in Malaysia and overseas. The new patents are related to an optical receiver which enables a transmission-reception range that exceeds three metres; a smart home system; and a low latency system.”

“And we are expecting to launch our products in August 2022,” he said, adding that the next big step would involve commercial funding.

“As a team, we are going into our first commercial funding at the seed stage. With sufficient funding, we will push quickly into a few countries where we wish to be dominant in terms of patents, IP rights and market coverage.”

“We have two existing partners. One is a contract manufacturer in Penang, and the other is a marketing arm in China which is also sourcing raw materials and components for us at affordable costs,” he explained.

According to Dr. Tan, the market potential is enormous. “We are going into a market wherein mass-market consumers will be using our system. Based on a survey, the total market potential is close to US\$500 billion globally,” he said.

As Terra Phoenix gets ready to step into the global limelight, Dr. Tan takes pride in tracing its roots in Malaysia.

“Terra Phoenix is a spin-off from the Multimedia University (MMU). I was an Associate Professor of Engineering at MMU, and 10 years ago, I was one of the lucky guys that received CREST’s support to develop our first-generation prototype. In December 2020, we landed another agreement with CREST for our third-generation prototype.”

“Today, our prototype has reached a technology level of 8. I truly thank CREST for the continuous support. We look forward to significantly changing the world of telecommunications,” he said.

Commenting about his relationship with CREST, Dr. Tan said:

“I have been working in many countries and many funding agencies. I would like to highlight two significant features in CREST’s DNA which makes it unique.”

“The first is professionalism. CREST personnel is very clear on the processes and principles of research funding. I would say your level of professionalism is the highest that I have encountered at every level, from the clerical level to the executive level to the top management level, when it comes to reviewing our projects. When it comes down to the principles of research funding, your professionalism is just perfect.”

“The second thing is: CREST focuses on patents and IP rights. This is something that is not available elsewhere. Actually, I think that the whole country knows about this.” I have met Dr. Mohd Norazmi Alias, Dr. Mohamad Hazwan Mohd Daut, Ms. Lim Poi Hong, Mr. Lim Hoo Kooi, Mr. Fouzun Naseer M N Mohd Yusoff and others. Their expert knowledge and sincere support have greatly motivated us to go further at every level.”

DR. TAN CHING SEONG

Group CEO of the Terra Phoenix Group of Companies.

Dr. Tan was previously the Director of the Department of Electromechanical and Biomedical Engineering, UTAR University (Founding Department Head) and was responsible for establishing the Department of Electromechanical and Bioengineering, leading the team to solve the problem of optical simulation scenarios.

He was then promoted to Associate Professor of Multimedia University, responsible for establishing the Engineering Research Institute, improving the level of research and development and establishing a university industry-university-research consortium.

For two years, he was invited to be Colorado State University Visiting Scholar. Currently, he is holding significant roles as founder, chairman, and CEO of several companies in Malaysia and China – iCYCLE Malaysia Sdn. Bhd., Malaysia and Zhejiang Aifenghuan Environmental Technology Co., Ltd., China.



A MORE ENERGY-EFFICIENT IC THAT HARVESTS AND REUSES RF ENERGY: THE INFINECS SYSTEMS, UM, USM, APU & CREST STORY.

Basically, **DATO' CHEOK LAY LENG**, the co-founder of Infinecs Sdn Bhd, said the project is about developing a better and low-cost energy harvesting system for low-power applications that will support advancements in the Internet of Things (IoT).

“The aim is to develop a highly efficient integrated multiband radio frequency (RF) system for wireless sensor applications.”

“The scope encapsulates the development of new circuit designs to achieve high harvesting sensitivity through Q-factor improvement. Efficiency enhancement can be achieved by reducing the forward conduction and leakage current of the RFDC rectifier (which converts RF energy into DC voltage) and reducing the power consumption of the power management unit,” he added.

To make things clearer, Dato' Cheok outlined the benefits in terms of:

- Convenience and user-friendliness

“Think about smaller, better, and more reliable smart wearables and portable computing devices. Wearable refers to a smart device that you can wear anywhere; and portable means you can carry it everywhere. However, wearable and portable need not necessarily mean users must bring replacement batteries everywhere or recharge ever so often. So, for things like smart watches, heart monitors and other health-monitoring devices,

smartphones, laptops and video cameras, the applications could be very interesting.

“Battery replacement for any smart device or sensor that is operating in a remote off-grid area can be inconvenient. Hence, an RF energy harvesting circuit that extends battery life, and reduces the frequency of battery replacement or recharging opens up the viability of deploying more devices or sensors in more remote locations and areas wherein the power supply is inconsistent or unreliable.”

- Environment-friendliness

“An alternative way to harvest and reuse energy may be considered to be a way to generate renewable energy. If we can reduce the usage of batteries, we can reduce the disposal of batteries as harmful waste. Used batteries are considered to be atomic waste, which can harm the environment.”

- Cost-efficiency

“Frequent replacements can get expensive.”

“Perhaps, our new way of harvesting renewable energy can also replace the need for battery power to enable some smart devices or mobile apps. So, potentially, the results of our Collaborative R&D venture will be beneficial for high-volume mass market applications in various fields of technology,” he said.

The project involves research work by Malaysian universities to probe into new applications and advanced technologies. Infinecs’ local R&D partners are:

- Universiti Malaya (UM), a public university that is designing and developing a complete multi-band RF energy harvesting system with better performance;
- Asia Pacific University of Technology and Innovation (APU), a private university, that is involved in system integration, validation and on-site experiments; and

- Universiti Sains Malaysia (USM), a public university that is developing the test bench for characterisations in a laboratory.

"We are in the business of providing design services. So, Infinecs plays an in-depth technical role in making this project successful. I thank CREST for staging this project. We were approached by CREST to participate and we gladly took on the opportunity to work with the universities," Dato' Cheok said.

According to him, this RF energy harvesting project has marked eight milestones as of April 2022.

"I think two conference papers have already been published. Two fabrications of prototypes and four circuits have also been completed."

"The two front-end circuits have been completed to include high-efficiency and high-sensitivity rectifiers and a re-configurable circuit capable of harvesting two frequency spectrums."

"I believe we have achieved good progress: we have already developed the tools to support energy harvesting from 2 RF ranges. The next stage is to look into harvesting energy from a 3rd frequency range," he explained.

Looking ahead, he said, the team also needs to consider the design and integration of a high-power conversion or efficiency charge pump.

"A charge pump is a big capacitor that accumulates and stores the charges. Its characteristics will ensure that we can store sufficient charges for a certain period. That needs to be studied."

"So, there is still much characterisation work to be done. When the proof of concept devices are back for characterisations, we should be able to fine-tune and create more robust and stable solutions," he added.

The deadline for full completion of the project, Dato' Cheok said, had been set for June 2023.

"The deliverables include a fully developed prototype of a high-efficiency, integrated RF energy harvesting circuit capable of harvesting 3 RF frequency spectrums. We will then publish papers, and, hopefully, submit 2 IPs for patenting," he added.

DATO' CHEOK LAY LENG

Co-Founder, Infinecs Systems Sdn. Bhd..

Dato' Cheok spent over 35 years in the semiconductor and electronics industries. He has worked in California, Arizona USA, Japan, Hong Kong, China and Malaysia in design engineering, platform technologies, marketing, business operations, managing global organizations at Intel Corporation and chief executive for technology start-ups.

In 2016, he co-founded Infinecs Systems Pt Ltd, which delivers advanced semiconductor and embedded system design and engineering services in Malaysia, India and the USA.

He has served on technical advisory and academic boards, as well as presented at industry conferences and events. He is a pioneer and board member of Tech Dome Penang and SFP Tech Holdings Berhad. He had also served on the board of Tenaga Nasional Berhad in 2020. He is currently serving the Penang state government as the CEO of Penang Hill Corporation.



5

WHAT'S NEXT?
On the menu.



Watch video

Industry insight has often been cited as one of CREST's key attributes. And, that is not necessarily limited to colourful past events and sobering present challenges.

This chapter shares some insights into the technologies, trends and consumer demands that are shaping (or re-shaping) the global high-tech manufacturing arena, as of 2022.

Foretelling the future is a tricky business at best. More so in regard to the rapidly evolving worlds of technology and high-tech manufacturing.

But, what if you were to ask a few leaders of leading MNCs (and one emerging LLC) operating in Malaysia to talk about their takes on the prospects for the future?

It is not by accident that these leaders also happen to represent companies that are listed amongst CREST's 111 members.

So, these are the forward-looking insights of industry insiders. Some of whom have "been there and done that" through the years and who are still looking forward to a brighter future in Malaysia, for Malaysia.

GaN TECHNOLOGY

DR. DAVID LACEY



Gallium nitride (GaN) is an example of a compound semiconductor. A compound semiconductor is a new class of semiconductor materials that can do things silicon cannot do.

There is one specific value of a compound semiconductor: it can emit light efficiently. In the optoelectronics/light-emitting diode (LED) industry, GaN is now being used to manufacture state-of-the-art LEDs that can emit light across a broad range of frequencies.

The other valuable attributes of a compound semiconductor class material are high reliability and high efficiency. With those attributes, you can make power transistors and power devices that are smaller, yet more fundamentally efficient.

So, that means that the power supplies for future wearables, smartphones, tablets and laptops can be smaller yet more powerful, and perhaps, can be charged faster.

The use of compound semiconductors should also generate a positive impact in the automotive industry, specifically in the production of electric vehicles (EVs). The overall efficiency of future EVs can be improved because conversion losses can be reduced as wallplug-to-battery losses and battery-to-motor losses are significant areas where Compound Semiconductor tech can provide big improvements.

So, the EVs of tomorrow may have more responsive engines and still offer an extended range of operations.

Compound semiconductors can also enable the development of more reliable and efficient radio frequency (RF) devices, including the transmitter and receiver in a smartphone.

So, compound semiconductors (like GaN) will enable the development of a new generation of smart electronic devices. These next-gen devices are likely to be more efficient and reliable, smaller, lighter, and, therefore, more ergonomic.

In other words, more user-friendly.

As I have mentioned, Malaysia already has all the technological building blocks for GaN technology in place, including crystal epitaxy, fabrication and packaging, as well as CMOS technology for integration.

ADVANCED IC DESIGN

MR. CHEAH HUN WAH

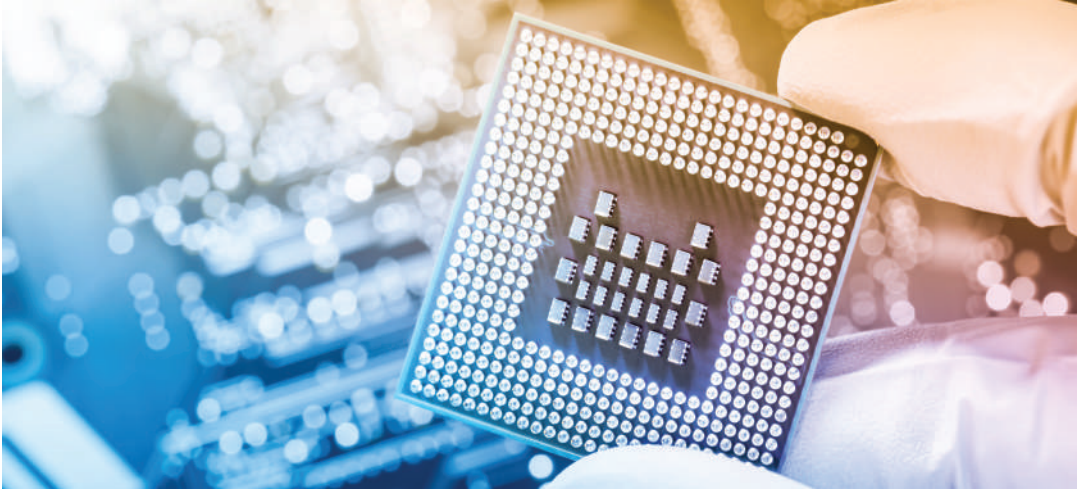
Since the 1970s, global semiconductor MNCs have been continuously packing more and more transistors (binary switches) into integrated circuits (ICs) to boost computing power in personal computers (PCs), smart electronics gadgets and equipment.

However, in today's advanced IC design world, we do not only focus on the number of transistors within a given space (on one chip). The challenge is to "collectively use the given transistors in a more time-efficient way."

We can deploy more ICs to work simultaneously in a networked configuration if more computing power is required. In doing so, we can design ICs that function more time-efficient and power-efficient ways within a multi-IC ecosystem. These "timed" ICs can work collectively to get the job done.

So, there is a shift in the IC design mindset from "space" to "time." Today, you can find tens of billions of transistors on a single smartphone made by any of the top 5 manufacturers in the world. The transistor count in your new smartphone is higher than the world's population (8 billion people as of June 2022).

However, not all of those transistors are located within a single IC. So, we now talk less about a global MNC's dominance in IC design and more about how to design ICs that can be united to work collectively to enable multiple applications in smart devices. We are in the age of designing specific ICs that can function efficiently as the components of an integrated and "customised" solution for each industry.



First, there will be a new generation of ICs to replace the old with better performance, more energy efficiency and in a smaller footprint. For example, in the electric vehicle (EV) industry: there were a few hundred ICs in an early-generation EV. Today, you can expect thousands of ICs in a 2022 model EV. Then there is another trend of consolidation/integration among a few ICs with further opportunities to improve efficiency, energy consumption, system failure rates (due to many subcomponents), and space constraints. All these will lead to more design opportunities in the coming decades.

And, as more artificial intelligence-driven (AI-driven) products hit the market, you can expect to see more demand for ICs and IC ecosystems to support these products. The same applies to the smartphone industry, wherein future devices will be packed with even more ICs to offer more advanced functions to consumers.

Malaysia is a beautiful country with a geographical advantage. We have so many experienced MNCs here that have been operating for so many decades.

We also have many LLCs and SMEs providing various support to the MNCs and an established global supply chain network that works.

As such, we are in a good position to capitalise on the latest trends in the EV, AI and smartphone industries. Moreover, with CREST, we can now work towards generating more IPs and patents for our home-grown Collaborative R&D work.

If we continue to innovate, we may even be able to churn out some fantastic “made-in-Malaysia” tech toys for the global market in the future.

LEDs AND OPTOELECTRONICS

DR. DAVID LACEY

Over the last 10 years, Malaysia's LED and optoelectronics industry has focused on efficiency and low cost. So, our LEDs are now close to the theoretical maximum efficiencies, and we will certainly get there in the next few years.

We are in a phase of miniaturisation now. We have "shrunk LEDs" to be much smaller in physical size. This development opens up an ample future of opportunity for the optoelectronics industry.

When I say LED displays, you would think about large outdoor video walls or advertising displays in cities worldwide.

Can you imagine shrinking that LED display to become the TV in your home, the display on your smartphone, your smart watch, or a display in your spectacles?

One of the "hot tech areas" at the moment is augmented reality (AR) or virtual reality (VR). The idea of projecting images within your range of vision using very small optoelectronic display systems can create a global market for a new generation of high-tech eyewear.

The second key prospect area for the LED and optoelectronics industry is called "distributed arrays." This means that instead of packing minute LEDs tightly together to form a display, you spread out the LEDs in a way that human eyes will still perceive that array as one complete or continuous picture.

There can be a lot of space between the arrayed LEDs. You can put other things in that space.

This is a potentially exciting area for making “combined devices”, for instance, combining cameras with displays or sensors with displays.

The third interesting prospect is linked to the drones and autonomous vehicle industry, called Light Detection and Ranging or LiDAR. By deploying an infrared laser and light sensors, you can allow a drone or a car to see where it is going.

Using optical data gathered by a pair of eyes, a human brain is good at computing 3D vision using visible light. The easiest and most accurate way for a computer to construct a 3D image is by using data gathered through LiDAR technology.

So, the idea of wider usage of high-powered infrared lasers and optical sensors for drones and autonomous vehicles represents another opportunity.

People have invented new ways to use LED and optoelectronics technology. Now, the industry needs to translate these inventions into marketable products.

We always say innovation is actually getting something into the market where it has an impact.

Malaysia is a great place to do that. We have the manufacturing infrastructure here. Together with CREST, we have made sure that we also have the scientific knowledge and R&D talent to develop those technologies into products and really innovate.

THE INTERNET OF THINGS (IOT)

MR. ERIC CHAN WAI PHANG



Most of us are familiar with the evolution of the personal computer (PC). An embedded system is similar to a PC in that they share the same hardware, software and architecture...but with one big difference:

An embedded system is designed to run specific applications when deployed in specific locations. Examples include self-order kiosks in fast food outlets, automated teller machines (ATMs) in banks and robots in factories.

The Internet of Things or IoT describes the evolution of embedded systems whereby we connect these systems online to monitor, operate, update and manage these systems remotely.

Now that we have real-time access to the Internet, we can extract raw data from the embedded systems in real-time and apply artificial intelligence (AI) to convert this raw data into immediate insights that guide us towards achieving business goals.

For example, a self-checkout system at a fast food outlet records data on what customers are ordering in real-time. The fast food operator can use the data to enable an uninterrupted and smooth supply of popular items and plan promotions for items that are not selling that well.

In the case of the robots in a factory, these robots can get better at designated tasks through “training” using AI algorithms. Over time, a robot can be “trained” to improve its accuracy and quality of work.

A key area that we are working on is getting ready for 5G. We foresee the deployment of 5G soon because it offers a broader band, lower latency and potentially more secure connectivity.

We believe that the combination of 5G+AI+IoT will be a good recipe for autonomous robots in a factory; for many robots to be connected in real-time to carry out high-precision operations. So, we plan to combine or integrate the full advantages of these technologies to improve performance and productivity.

Now, manufacturing is a huge economic engine for Malaysia. We benefit from having a large manufacturing base in Malaysia with many MNCs and local SMEs already invested in Malaysia. And we have a strong talent pool. Therefore, I would say that we are a little ahead of the game.

However, other countries may also have the right talent, the right set-up and connections to a high-tech global supply chain.

As such, Malaysia needs to seriously consider investing more in IoT to stay ahead of its Industry 4.0 requirements and the transition to “smart manufacturing.” We need to invest and harness IoT to stay competitive, productive and successful.

This is where CREST can play a pivotal role in leading the initiative to do more collaborative research on IoT and related Industry 4.0 and AI applications.

There is also much to do to get our existing and future talents to train themselves in readiness for advancements in IoT technology. We need to train more Malaysians up to the leading edge level so that they can take on careers that will drive these technologies into the future.

Malaysians must be on par with talents in some of the other development centres across the globe. Talents in other countries have full access to a support framework to make them even better as they compete globally.

We have done some work with CREST, such as setting up cloud-based solutions, data centres, labs and certifications. All these need to come in so that even start-ups, SMEs or MNCs have access. However, more needs to be done.

In other words, the second challenge is: How can we bring more tech knowledge from the MNCs, SMEs and the research on IoT to be shared continuously across the country and among our people? A lot of ideas could come from some of our young talents. If they are knowledgeable, they will present fresh perspectives.

So, the advent of IoT developments in Malaysia can present great economic opportunities and benefits to Malaysia and Malaysians, in terms of improved productivity and enhanced future career prospects.

Thirdly, there are also concerns, or “hindrances,” that may affect the pace of IoT deployment related to cyber-security. As we open up the industry and other economic sectors to be more online and interconnected, we are also potentially more open to cyber-attacks.

Today, we have cyber-security measures at the silicon level (for example, from Intel), operating system level (OS-level) and software level.

But when you think about it: The battle for cyber-security never really ends because technological advancements may also open up new opportunities for hackers.

So, Malaysia will also need a pool of highly talented people who are very savvy in software, hardware and high technology to manage cyber-security effectively as we continue to expand the boundaries of IoT. We need talent who can continuously level up cyber-security so it becomes difficult for hackers to attack our IoT, AI, Industry 4.0 and smart manufacturing systems.

Preferably, we can make our systems so hard to penetrate that most hackers will just give up because it is not worth their time.

I think this is where CREST can also play a role. Partner with the industry and the universities to do some deep research into cyber-security to collaboratively achieve some worthwhile breakthroughs.

At the very least, we can aim at providing better protection for our digital economy. If things go well, we may even nurture the creation of a talent pool or an industry focused on cyber-security, not only for Malaysia but for the global market as well at the chip, OS and software levels.

INDUSTRY 4.0

MR. T.K. TAN

As I understand it: Industry 4.0 is about harnessing state-of-the-art technologies - involving hardware, software and the Internet - to optimise manufacturing processes for a complete supply chain from a supplier to a manufacturer to the customer.

For Clarion Malaysia, a supplier can be a raw material vendor or a sub-assembly plant. We are the manufacturer, and our customers are car makers.

Industrial 4.0 will allow us to plan and initiate the orders for raw materials, parts and components. In the Clarion Malaysia factory, it will allow my team to design and assemble a product efficiently, swiftly and to specifications. And, it will allow us to deliver or ship products quickly to a customer waiting to put them in a car. Everything can be done online, and should happen within an optimal timeframe.

In Malaysia, we have access to a lot of raw materials and components. We also have easy access to raw materials and components that can be sourced across Asia.

Through CREST, we have forged collaborative R&D relationships. Most MNCs in Malaysia have also set up their R&D and design facilities. We have high-tech manufacturing plants, some of which have been operating for 50 years. We have a global supply chain that works well.

This means we have all the building blocks in place to “automate” the whole high-tech manufacturing chain, from start to end.

However, we need to focus on connecting all the dots using the latest technologies. For Industry 4.0 to take off, we need to mesh software and integrate the systems to:

- *Securely connect to all the key vendors and sub-assembly plants in Malaysia (and across Asia if possible) to enable fast purchasing, shipping and acquisition of all the raw materials and components required;*
- *Match customer demands to viable solutions;*
- *Support timely deployment of operations in existing Malaysian manufacturing plants that are becoming increasingly automated;*
- *Alert manufacturers quickly to various issues that may arise; and*
- *Help manufacturers to plan and implement the fastest methods to move finished products at any given time, to reach the customer on time.*

Ideally, this whole chain of events will also be transparent to the customers so that they can monitor progress and plan ahead for arrival.

Successful implementation of Industry 4.0, involving all related parties in Malaysia, will solve many issues for high-tech manufacturers. It will improve cost-efficiency and time-efficiency and drive productivity to new heights. It will set a new level of professionalism for the high-tech manufacturing sector in Malaysia.

Industry 4.0 is not another buzzword. It is a no-brainer for Malaysia.

It is something that we must do and we need to do it well. Otherwise, we may no longer play a role in the increasingly competitive global high-tech manufacturing game.

So, we need to move quickly to ensure Malaysia captures the advantage.

I think it is our role right now, in CREST, to set a clear course and share information effectively amongst our members. CREST members need to play their roles by preparing themselves after we map out rational ways for the E&E industry to evolve.

Then, we need to let the Malaysian Government know exactly what needs to be done to provide institutional and framework support to enable Industry 4.0. After that, we can get every MNC in Malaysia into Industry 4.0 mode.

To date, no country has managed to address the challenges of Industry 4.0 comprehensively and adequately. Malaysia may be the first country to do so.

DRONES, EVs & AUTONOMOUS VEHICLES



DATO' OOI BOON CHYE

DR. DAVID LACEY

MR. T.K. TAN

MR. CHEAH HUN WAH

DATO' OOI BOON CHYE:

You can see how critical drones has become in various applications. So, I believe that drone manufacturing is a potential growth area for Malaysian tech companies.

If Malaysia can send a man and launch satellites into space, we should be able to build drones, right? If you can get good software and engineering, you can make drones very useful in Asia.

As for autonomous vehicles: I think the driverless part of it offers us a huge opportunity.

Maybe the market in Malaysia is too small for us to think about developing an entire autonomous vehicle system. But, that system has so many electronic components as well as electronic software, laser systems and so forth. There are so many sub-systems, right? We could still participate even if we do not participate in building a whole car yet.

I heard that an electrical vehicle (EV) has about 5,000 ICs now. These ICs must operate in real-time. They cannot send a message and wait for a reply as that would be too slow. Things can go awry in a split second when a vehicle is moving.

We can focus on making something easy to start with, such as components or modules. These things are well within our reach for because we already have access to a lot of the related technologies for other applications. We just need to put things together and provide solutions.

MR T.K. TAN:

Today, we are no longer referring to cars as mechanical devices. Let me share my perspective on the latest “software-defined vehicle” or “connected car.”

It runs on software, and it has lots of electronics. It is all about electrification: the power plant is a bank of batteries that needs to be recharged optimally.

It is practically an IoT device-on-the-move. Connected cars are becoming part of the ecosystems of smart cities. When we look inside an autonomous vehicle, we see that it is equipped with components and products that

are being manufactured in Malaysia today. Everything works better with electronics and software today. More things will need more electronics and more software in the future. So, drones and autonomous vehicles are like sub-sets of where the world is heading towards in the future.

If we look at the big picture closely, we will find that we have the raw materials here. The chips are here, and the researchers and engineers are here. The high-tech manufacturing factories are also here. We also have extensive experience in designing and manufacturing high-tech products using advanced technologies.

Many neighbouring countries which are competing with us (technologically) do not have all the things that we have. Yes, they may be stronger in one area but may also be weaker in other areas. And, they may not have certain resources at all.

On the other hand, we, who have it all, are not taking full advantage (yet). So, maybe, we need a bit of patience as we focus on how to get on board and more involved in the drones and autonomous vehicles sector in one way or another.

We just need to keep going at it, and we can achieve amazing things. Let us just make sure we do not stop pursuing new opportunities. Take, for example, LiDAR. You need LiDAR to get drones and autonomous vehicles to “see in 3D”. Can we design and manufacture a LiDAR system?

Clarion Malaysia designs and makes automotive components. My answer is: I do not think it is that difficult. It is just another product. Can we get the components for LiDAR? Dr. David Lacey is here with us. He is from ams-OSRAM, one of the global leaders in optoelectronics. Optoelectronic products is one of the key components of a LiDAR system.

Drones run on batteries. Future autonomous vehicles will be electric vehicles (EVs). 50% of the technology in an EV is battery technology. If you do not have powerful batteries, you do not have marketable drones, EVs or autonomous vehicles.

And we have Dr. Lacey here talking to us about the great potential of GaN technology for power applications in the future. He has also told us that CREST has helped us to complete the GaN manufacturing value chain in Malaysia, from epitaxy to fabrication to packaging. And more MNCs are looking to invest in GaN technologies in Malaysia.

So, the question remains : “Are we going to do it or not?”

DR. DAVID LACEY:

I agree that we already have the building blocks in Malaysia, as pointed out by Mr T.K. Tan.

If you look closely at all the components you need to build a drone, EV or autonomous vehicle, many of those key components are already being manufactured here.

In terms of E&E products, Malaysia has a significant global contribution. It is just that Malaysia has not really leveraged (its manufacturing resources) to build its own drones, EVs and autonomous vehicles.

So, we have to be careful now so as not to stumble into a process of reinventing the wheel. We should build on what Malaysia has been doing and then direct our existing technologies towards enabling the design and manufacture of such devices and vehicles in our environment.

We do not have a great deal going on yet, but it is doable.

MR. CHEAH HUN WAH:

From the IC design standpoint, I concur that we have the building blocks in Malaysia.

I see opportunities in designing better ICs for radio frequency (RF), battery management and LiDAR applications in drones, EVs and autonomous vehicles. Small design changes can make big differences.

The advanced ICs in these machines probably have a billion transistors on board. Not only that, we need to think about the architectures for each system's sub-categories which are system-on-a-chip driven (SoC-driven). The other part is the software or artificial intelligence (AI) that is needed to get everything to work together and operate properly in real-time, all the time.

Nevertheless, if our country is ready to take on the challenge in these arenas via CREST's Collaborative R&D platform, I think we already have the right weapons and warriors to go into battle.

PARTING WORDS

It would be fair to say that everyone who participated in the CREST10 project enjoyed, at least, the process of speaking their minds.

Hopefully, you have enjoyed reading about CREST, seen primarily through the eyes of others. Also, hopefully, this book has been as interesting to read as it was to write it.

Looking back, the past is what it is. It cannot be changed. History and facts dictate that many people did many things for different reasons to make CREST “happen,” while many others helped it to chart key milestones over a 10-year period.

The future, they say, is always promising, but it is yet to happen. And if there is an important lesson to be learned from the Covid-19 outbreak, it is related to this combination of words: “best schemes,” “mice” and “men” by Robert Burns.

This leads us to the present.

CREST is here, the E&E industry is here and the universities are here. We are now all connected or intertwined in one synergistic and symbiotic network. Malaysia is now in the “endemic phase,” and everyone is racing towards socioeconomic recovery.

For CREST, the challenges have been identified, and the map leads to higher ground. Many people whom we have engaged, including the students and undergraduates, are clearly still excited and enthusiastic. They are waiting for CREST to lead the Collaborative R&D charge onwards.

Let us get on with the work we have to do.

Thank You.



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