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For discussion
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Legislative Council
Panel on Commerce and Industry

Progress Report of Research and Development (R&D) Centres for 2014-15
cum
Comprehensive Review on R&D Centres for 2011-12 to 2014-15

PURPOSE

The purpose of this paper is threefold –

(a) report progress of the R&D Centres set up under the Innovation and Technology Fund (ITF) in the year of 2014-15 (**Part A of the paper**);

(b) report findings of a comprehensive review on the operation of the R&D Centres from 2011-12 to 2014-15 – a period of 4 years (**Part B of the paper**); and

(c) having regard to the outcome of the comprehensive review, submit a funding proposal to extend the operation of the R&D Centres established under the ITF to 31 March 2021 – an additional period of 4 years (**Part C of the paper**).

BACKGROUND

2. In June 2005, the Finance Committee (FC) of the Legislative Council (LegCo) approved vide FCR(2005-06)21 a total commitment of $273.9 million under the ITF for the establishment of four R&D Centres and their first five years of operation to drive and co-ordinate applied R&D in selected focus areas and to promote commercialisation. The four R&D Centres are –

(a) Automotive Parts and Accessory Systems R&D Centre (APAS);

(b) Hong Kong Research Institute of Textiles and Apparel (HKRITA);

(c) R&D Centre for Logistics and Supply Chain Management Enabling Technologies (LSCM); and

(d) Nano and Advanced Materials Institute (NAMI).

3. Following FC's approval, the four R&D Centres were established in April 2006. At the same time, the R&D Centre for Information and Communications Technologies (ICT) under the Hong Kong Applied Science and Technology Research Institute (ASTRI) was also established with its operating expenditure funded separately from Government's annual recurrent subvention.

4. In June 2009, having regard to the performance of the R&D Centres after an interim review, FC approved vide FCR(2009-10)27 an increase in the funding commitment by $369 million to extend the operation of the four R&D Centres up to 31 March 2014.

5. In 2011, we conducted a comprehensive review on the operation and overall performance of the R&D Centres for their first five years. With the support of the Panel and having regard to the outcome of the review, FC approved vide FCR(2012-13)21 in May 2012 an additional commitment of $275.3 million to extend the operation of the R&D Centres as follows –

(a) for NAMI and APAS which had met the interim industry contribution target of 15% in their first five years, their operation period was extended until 31 March 2017 and their industry contribution target was revised to 20%; and

(b) for HKRITA and LSCM which had not achieved an industry contribution of 15% in their first five years, their operation period was only initially extended to 31 March 2015. We undertook to closely monitor/review their performance during a two-year observation period ending March 2013 (i.e. two years after the last review) with a revised industry contribution target of 18%.

6. At the meetings of the Panel on 18 June 2013 and 19 November 2013, we briefed Members that both HKRITA and LSCM had exceeded the industry contribution target of 18% during the two-year observation period from 2011-2013 and their performance had shown sustained improvement and was generally satisfactory. With the support of the Panel, FC approved on 24 January 2014 vide FCR(2013-14)55 an additional $100.8 million to extend the operation of HKRITA and LSCM up to 31 March 2017 to align with the operation period of APAS and NAMI. **Their industry contribution target was also raised to 20%.**

7. In other words, **the FC has so far approved a total of $1,019 million out of the ITF to support the operations of the R&D Centres for 11 years from April 2006 to March 2017**.

STRUCTURE OF THIS PAPER

8. It has been an established practice for Government to report to the Panel annually the work of the R&D Centres. In line with this, **Part A of this paper** is a report on the performance of the R&D Centres in 2014-15.

9. In November 2014, we submitted the Final Report on the Comprehensive Review of the ITF to the Panel, in which we reported the latest performance of the R&D Centres up to September 2014 (some performance indicators of the R&D Centres such as the level of industry contribution, operating expenditure and R&D expenditure were however only updated to March 2014 since they are based on financial year). In the Report, we stated that we would conduct a comprehensive review of the R&D Centres covering the four-year period from 2011-12 to 2014-15 before making a recommendation on their way forward. Our findings are set out in **Part B of this paper**.

10. In general, the performance of the R&D Centres during this four-year period is satisfactory. For instance –

(a) they have taken up a significant role as the focal point for technology collaboration among the Government, industry, academia and research sector;

(b) they have obtained increasing support of the industry as demonstrated by a higher level of industry contribution over the years and that all of them have been able to exceed the latest target of 20%;

(c) in terms of commercialisation, some of the R&D Centres have started receiving more income other than industry sponsorship for ITF projects, including contract service income, licensing fees and royalties;

(d) they have made great effort in conducting trials in the public sector. Over the past few years, they have conducted over 70 trial projects in the public sector; and

(e) they have gradually made a name as the trusted R&D partner in their respective sectors.

11. As mentioned in paragraph 7 above, **the FC's approved operation period of the R&D Centres will expire in March 2017. In order to enable the R&D Centres to continue with their work, map out long-term goals and directions and enter into longer-term collaborative agreements with their partners, it is proposed, after considering the satisfactory performance of the R&D Centres as shown in the findings of the comprehensive review, to extend the operation of the R&D Centres for four more years until 31 March 2021.** Details of the proposal are set out in the **Part C of this paper**.

12. At the Panel meeting on 16 June 2015, we will show a short video on the work progress of the five R&D Centres in 2014-15. (Note: A more detailed version of the video will be sent to Members before the meeting and will be uploaded to https://www.youtube.com/TechHongKong.) Detailed reports prepared by each of the five R&D Centres are set out at **Annex A** to **Annex E** respectively.

PART A - PERFORMANCE OF THE R&D CENTRES IN 2014-15

13. In this part of the paper, we will analyse the performance of the R&D Centres in 2014-15 from the following angles –

(a) operating expenditure;
(b) level of industry contribution; and
(c) R&D projects and expenditure.

(A) Operating Expenditure

14. The operating expenditure of the R&D Centres and their staffing situation (as at end-March 2015) are as follows (figures of 2013-14 are provided for comparison purpose) –

Table 1: Operating Expenditure and Staff Strength

	($ million)		% change over 2013-14	Staffing Strength as at End-March 2015 [Establishment]
	2013-14	2014-15		
APAS	11.4	13.8	+21%	29 [33]
ASTRI	129.5	123.0	-5%	512 [563]
HKRITA	21.1	24.1	+14%	32 [39]
LSCM	20.4	24.8	+22%	58 [70]
NAMI	56.2	53.6	-5%	52 [61]

15. In 2014-15, the operating expenditure of –

(a) APAS has increased by 21% since it has strengthened its R&D team by filling some vacant R&D positions;

(b) ASTRI is still largely similar to previous years (slightly reduced by 5%);

(c) HKRITA has increased by 14% since it has hired additional R&D staff to enhance its in-house R&D capability;

(d) LSCM has increased by 22% since it has upgraded its technology showroom to better promote commercialisation and enhanced its server system to enhance data protection; and

(e) NAMI is still largely similar to previous years (slightly reduced by 5%).

(B) Level of Industry Contribution

16. R&D Centres are platforms for co-ordinating applied research in designated technology areas and facilitating technology transfer to the industry, and as such the level of industry contribution remains a most important indicator to demonstrate the degree of support of the industry in their work. The level of industry contribution of the R&D Centres in 2013-14 and 2014-15 are as follows –

Table 2: Level of Industry Contribution *(Note 1)*

	2013-14	2014-15	Change in Percentage Point (pp)
APAS	41.8%	35.2%	-6.6pp
ASTRI (Note 2)	19.3%	21.6%	+2.3pp
HKRITA	35.0%	28.6%	-6.4pp
LSCM	28.2%	31.4%	+3.2pp
NAMI	15.9%	23.2%	+7.3pp

Note 1: The level of industry contribution is calculated as follows –

$$\frac{\textit{Industry Contribution Pledged}}{\textit{Approved Project Expenditure}} \quad \textit{x 100\%}$$

Note 2: Starting from 2013-14, ASTRI has aligned its industry contribution calculation method with that of other R&D Centres.

17. **We are delighted that while there are some minor fluctuations for individual R&D Centres, the overall performance is satisfactory with all R&D Centres exceeding the target level of industry contribution of 20% in 2014-15.** In addition, all R&D Centres were able to achieve the overall average level of 20% for the four-year period from 2011 to 2015.

18. In 2014-15 –

(a) APAS has reported 6.6 percentage points less than the previous financial year since it has conducted more platform projects to strengthen its technology capability. However, its performance at 35.2% is still the highest among five R&D Centres;

(b) ASTRI has an increase of 2.3 percentage points;

(c) HKRITA has reported 6.4 percentage points less since it has conducted more projects under the Public Sector Trial Scheme (PSTS) which do not require any industry sponsorship;

(d) LSCM has an increase of 3.2 percentage points; and

(e) NAMI's performance has improved by 7.3 percentage points since its management has made a strategic change during the year to focus more on demand-driven applied R&D projects and by proactively reaching out and partnering with small and medium sized enterprises (SMEs) in Hong Kong.

(C) R&D Projects and Expenditure

19. The numbers of R&D projects of the R&D Centres in 2013-14 and 2014-15 are summarised as follows –

Table 3: No. of New Projects *(Notes 1&2)* and On-going Projects as at end-March 2015

	No. of New Projects Commenced			No. of On-going Projects		
	2013-14	2014-15	% change	As at Mar 2014	As at Mar 2015	% change
APAS	14 (7)	8 (3)	-43% (-57%)	23 (10)	26 (11)	+13% (+10%)
ASTRI	32 (3)	44 (3)	+38% (0%)	44 (4)	61 (5)	+39% (+25%)
HKRITA	25 (11)	25 (5)	0% (-55%)	43 (15)	57 (18)	+33% (+20%)
LSCM	13 (3)	17 (1)	+31% (-67%)	27 (4)	29 (3)	+7% (-25%)
NAMI	16 (4)	41 (16)	+156% (+300%)	37 (11)	55 (20)	+49% (+82%)

Note 1: Under the ITF, there are broadly two types of R&D projects:

(i) platform projects which require industry contribution of at least 10% of the project cost. The industry sponsors will not own the project intellectual property (IP). However, we have announced in February 2014 that the industry contribution requirement for projects initiated by Government bureaux/departments and statutory bodies with clear community benefits can be waived; and

(ii) collaborative projects which require industry contribution of at least 30% (for R&D Centre projects only) or 50% (for non-R&D Centre projects) of the project cost. The industry sponsor(s) will be entitled to utilise the project IP exclusively for a defined period or own the project IP.

The ITF also supports seed projects for the R&D Centres which are capped at $2.8 million per project. These are more forward-looking and exploratory projects and aim to provide foundation work for future platform/collaborative projects. No industry contribution is required for seed projects.

Note 2: Figures in brackets denote the number of collaborative projects.

20. The R&D expenditure of the Centres is as follows -

Table 4: R&D Expenditure ($ million)

	2013-14	2014-15	% Change
APAS	23.9	34.7	+45%
ASTRI	230.5	236.9	+3%
HKRITA	51.4	40.7	-21%
LSCM	45.6	35.1	-23%
NAMI	46.8	41.1	-12%
Total	**398.2**	**388.5**	**-2%**

21. It is noted that in terms of new projects –

(a) APAS has commenced 8 which is decreased by 43% from 14 compared to the previous financial year since it has developed a new technology roadmap in 2014-15 and would require some time to prepare new projects under the new roadmap, including recruiting and developing additional research personnel. Its R&D expenditure has however increased by 45% from $24 million to $35 million mainly due to satisfactory progress of new projects commenced in 2013-14, especially a large-scale collaborative project on pure electric bus;

(b) ASTRI has commenced 44 which is increased by 38% from 32 mainly due to the launch of a clustered-seed approach in early 2014, leading to the commencement of 10 seed projects in four clusters, namely Wireless Technologies, Internet-of-Things (IoT) Endpoints, Security and Image and Data Processing to further build up ASTRI's technological capability in areas with high potential for development and transfer to the industry. ASTRI's R&D expenditure has also recorded a growth of 3% from $231 million to $237 million;

(c) HKRITA has commenced 25 which remained unchanged. Its R&D expenditure has decreased by 21% from $51 million to $41 million mainly due to efforts in conducting more time-sensitive projects under the PSTS such as a project on high performance uniform for the Hong Kong Rowing Team to participate in the 2014 Asian Games;

(d) LSCM has commenced 17 which is increased by 31% from 13 since it has conducted more platform projects to build up its technical capability in respect of Internet-of-Things (IoT) and Radio-frequency Identification (RFID). Its R&D expenditure has reduced by 23% from $46 million to $35 million mainly due to some project implementation re-scheduling; and

(e) NAMI has commenced 41 which is increased significantly by 156% from 16. Among these projects, the number of new collaborative projects has recorded a significant increase from 4 to 16. This is due to NAMI's new focus on initiating market-driven research projects and proactively collaborating with SMEs across different market sectors. Its R&D expenditure has however slightly reduced by 12% from $47 million to $41 million, mainly reflecting the drop in new projects commenced in 2013-14 compared to 2012-13 (R&D expenditure on projects would usually be reflected in the one to two years subsequent to project commencement).

22. It should be noted that while the figures provided for a particular year are useful for understanding the work of the R&D Centres, mild year-on-year variations are sometimes inevitable and provided that the magnitude is not too great, they are acceptable. A more valid and reliable assessment of the R&D Centres would require the observation for a longer period, say two years or so. This is due to –

(a) the necessary lead time (hence impact on cash flow) for implementing an R&D project;

(b) short term fluctuations in market demand and economic situation which may affect the negotiations/discussions of the R&D Centres with their industry clients; and

(c) the wish of the R&D Centres to deliver certain public missions, such as the application of their technologies in the public sector, which may affect their short term performance indicators.

23. In general, we consider the performance of the R&D Centres in 2014-15 satisfactory.

PART B - COMPREHENSIVE REVIEW ON THE R&D CENTRES (2011-12 to 2014-15)

24. We have conducted a comprehensive review of the R&D Centres covering the four-year period from 2011-12 to 2014-15 (this is further to the last review on the R&D Centres which was conducted in 2011 covering the period from 2006 to 2011). During the review, we have analysed the performance of the R&D Centres from the following angles –

(a) level of industry contribution;
(b) number of new R&D projects commenced and project cost;
(c) operating expenditure;
(d) R&D expenditure;
(e) number of projects under the PSTS; and
(f) commercialisation.

(A) Level of Industry Contribution

25. The performance of the R&D Centres in terms of level of industry contribution is as follows –

Table 5: Level of Industry Contribution

	First 5 Years of Operation (06-11)	11-12	12-13	13-14	14-15	Four-year Period (11-15)
APAS	16.5%	13.9%	30.5%	41.8%	35.2%	37.6%
ASTRI	14.9%	20.2%	25.3%	19.3%	21.6%	N/A(*Note*)
HKRITA	12.4%	23.0%	26.8%	35.0%	28.6%	30.3%
LSCM	12.3%	15.4%	18.7%	28.2%	31.4%	23.5%
NAMI	31.2%	35.9%	39.0%	15.9%	23.2%	31.0%

Note: The level of industry contribution of ASTRI from 2011-12 to 2014-15 cannot be aggregated, since ASTRI has aligned its industry contribution calculation method with that of other R&D Centres from 2013-14. Previously it was different due to historical reasons.

26. From 2011 to 2015, the R&D Centres have become more mature and have taken up a significant role as the focal point for technology collaboration among the Government, industry, academia and research sector. This is demonstrated by the general upward trend of the level of industry

contribution over the years. In the four years, while there were some fluctuations, all R&D Centres have surpassed the target industry contribution level of 20%.

(B) New R&D Projects

27. The performance of the R&D Centres in terms of number of new projects commenced and the relevant project cost is as follows –

Table 6: No. of New Projects Commenced

	First 5 Years of Operation (06-11)	11-12	12-13	13-14	14-15	4-year Period (11-15)	9-year Cumulative (06-15)
APAS	47 (6)	6 (2)	6 (1)	14 (7)	8 (3)	34 (13)	81 (19)
ASTRI	196 (12)	27 (4)	38 (1)	32 (3)	44 (3)	141 (11)	337 (23)
HKRITA	51 (1)	14 (2)	19 (4)	25 (11)	25 (5)	83 (22)	134 (23)
LSCM	29 (2)	5 (1)	13 (2)	13 (3)	17 (1)	48 (7)	77 (9)
NAMI	45 (17)	15 (5)	22 (7)	16 (4)	41 (16)	94 (32)	139 (49)
Total	**368** **(38)**	**67** **(14)**	**98** **(15)**	**100** **(28)**	**135** **(28)**	**400** **(85)**	**768** **(123)**

Note: Figures in brackets denote the number of collaborative projects.

Table 7: Project Cost of New Projects Commenced ($ million)

	First 5 Years of Operation (06-11)	11-12	12-13	13-14	14-15	4-year Period (11-15)	9-year Cumulative (06-15)
APAS	153.8 (21.2)	7.9 (3.2)	16.3 (5.5)	87.0 (70.2)	35.7 (20.6)	146.9 (99.5)	300.7 (120.7)
ASTRI	1,552.5 (145.1)	227.2 (27.6)	246.5 (5.2)	279.8 (35.3)	334.2 (31.4)	1,087.7 (99.5)	2,640.2 (244.6)
HKRITA	179.7 (3.2)	28.1 (5.3)	52.7 (14.0)	84.2 (41.9)	43.7 (11.8)	208.7 (73.0)	388.4 (76.2)
LSCM	221.1 (3.9)	20.4 (1.2)	67.9 (3.2)	42.7 (4.6)	83.9 (9.9)	214.9 (18.9)	436.0 (22.8)
NAMI	205.8 (103.1)	63.4 (43.6)	89.7 (59.8)	26.0 (6.4)	88.4 (36.8)	267.5 (146.6)	473.3 (249.7)
Total	**2,312.9** **(276.5)**	**347.0** **(80.9)**	**473.1** **(87.7)**	**519.7** **(158.4)**	**585.9** **(110.5)**	**1,925.7** **(437.5)**	**4,238.6** **(714.0)**

Note: Figures in brackets denote the number of collaborative projects.

28. From 2011 to 2015, the total number of new projects commenced by the R&D Centres was 400, averaging 100 per year. This compares favourably with the average annual number of new projects of 74 per year in the first five years of operation from 2006 to 2011. The total project cost of the newly commenced projects from 2011 to 2015 was $1,926 million, averaging $482 million per year. This represents an increase of 4% as compared with the average project cost $463 million per year from 2006 to 2011.

29. From 2011 to 2015, the R&D Centres have also become more proactive in engaging industry partners in conducting collaborative projects. They have commenced a total of 85 collaborative projects from 2011 to 2015, averaging 21 per year, a significant increase compared to a total of 38 projects in the first five years combined. This represented the increasing confidence of the industry in the value-addedness of the work of the R&D Centres. The total project cost of collaborative projects commenced from 2011 to 2015 was $438 million, 58% more than the total project cost of the first five years combined.

30. Generally speaking, the industry partners of the R&D Centres for collaborative projects would contribute at least 30% of the total project cost and they would be entitled to an exclusive right to utilise the project intellectual property (IP) or own the IP. We note that there is a higher chance for the project outcomes to be adopted by the industry partner who will be responsible for commercialising the project outcome. However, platform projects are important in building up a pool of technological expertise/IPs for long term benefit.

(C) Operating Expenditure

31. The performance of the R&D Centres in terms of operating expenditure is as follows –

Table 8: Operating Expenditure ($ million)

	Approved Funding Commitment up to March 2017	First 5 Years of Operation (2006-11)	4-year Period (2011-15)	9-year Cumulative (2006-15)
APAS	228.2	70.4	60.4	130.8
ASTRI	N/A	526.3	505.4	1,031.7
HKRITA	197.7	47.0	80.3	127.3
LSCM	207.9	64.3	85.2	149.5
NAMI	385.2	84.5	183.2	267.7
Total	**1,019.0**	**792.5**	**914.5**	**1,707.0**

32. From 2011 to 2015, the operating expenditure of the R&D Centres was $915 million, averaging $229 million per year. This represents an increase of 44% as compared with the average annual operating expenditure of $159 million from 2006 to 2011. The R&D Centres have committed additional investment to step up their efforts to commercialise and apply their R&D outcomes as their technological capabilities have become more mature. Some R&D Centres, such as HKRITA and NAMI, have also hired additional R&D personnel for enhancing their in-house research capability.

(D) R&D Expenditure

33. The performance of the R&D Centres in terms of R&D expenditure is as follows –

Table 9: R&D Expenditure ($ million)

	First 5 Years of Operation (2006-11)	4-year Period (2011-15)	9-year Cumulative (2006-15)
APAS	89.9	92.6	182.5
ASTRI	1,114.0	1,030.4	2,144.4
HKRITA	98.0	157.6	255.6
LSCM	139.4	164.1	303.5
NAMI	89.5	185.8	275.3
Total	**1,530.8**	**1,630.5**	**3,161.3**

34. From 2011 to 2015, the R&D expenditure of the R&D Centres was $1,631 million, averaging $408 million per year. This represents an increase of 33% as compared with the average annual R&D expenditure of $306 million from 2006 to 2011. This is a healthy and gradual increasing trend for the R&D Centres in implementing a wide variety of R&D projects.

(E) PSTS Projects

35. The performance of the R&D Centres in conducting projects under the PSTS is as follows –

Table 10: No. of Projects under PSTS

	11-12	12-13	13-14	14-15	**Total (2011-15)**	Project Cost ($ million)
APAS	2	2	4	0	**8**	5.8
ASTRI	0	2	0	5	**7**	17.8
HKRITA	6	6	4	13	**29**	26.5
LSCM	2	5	7	10	**24**	60.6
NAMI	0	0	2	6	**8**	5.3
Total	**10**	**15**	**17**	**34**	**76**	**116.0**

Note: The PSTS was launched in March 2011

36. Since the launch of the PSTS in March 2011, the R&D Centres have proactively made use of the Scheme to apply their R&D outcomes in various public sector organisations, including Government departments, public bodies, charitable orgnaisations, and industry associations such as Hong Kong Retail Technology Industry Association and Hong Kong Intimate Apparel Industries Association. As at March 2015, they have conducted a total of 76 projects in the public sector under the PSTS, involving a total project cost of $116 million. For the previous few years, there was a gradual increase of the projects under PSTS from 10 in 2011-12 to 15 in 2012-13, 17 in 2013-14 and 34 in 2014-15.

37. With the R&D Centres becoming more mature in their respective focus areas, we see the need to encourage inter-centre collaborations to cope with topical social or economic issues. For example, we have been actively coordinating efforts of various R&D Centres in improving the livelihood of the elderly through the use of technologies. Details of our work on this front are set out at **Annex F**.

(F) Commercialisation

38. The performance of the R&D Centres in terms of commercialisation income is as follows –

Table 11: Commercialisation Income ($ million)

	First 5 Years of Operation (2006-11)	4-year Period (2011-15)	9-year Cumulative (2006-15)
APAS	0.8	0.9	1.7
ASTRI	29.6	96.2	125.8
HKRITA	5.3	3.3	8.6
LSCM	17.8	0.9	18.7
NAMI	2.7	17.4	20.1
Total	**56.2**	**118.7**	**174.9**

39. In recent years, the R&D Centres have started receiving more income other than industry sponsorship for ITF projects, including contract service income, licensing fees and royalties. From 2011 to 2015, the commercialisation income of the R&D Centres was $119 million, averaging $30 million per year. This represents an increase of 164% as compared with the average annual commercialisation income of $11 million from 2006 to 2011.

ANALYSIS BY R&D CENTRE

40. The key achievements of each R&D Centre in the past four years are highlighted in respect of –

(a) R&D achievements;
(b) commercialisation and technology transfer to the industry;
(c) application of R&D outcomes in the public sector and benefits to the community; and
(d) other key developments such as networking and collaboration with stakeholders.

(A) APAS

41. The mission of APAS is to become a leading automotive parts and accessory systems R&D centre in our region and assist Hong Kong's foundation industries to enter into or expand in the automotive market. The three major technology focus areas of APAS' technology roadmap include –

(a) green transportation;
(b) smart mobility; and
(c) materials and manufacturing.

R&D Achievements

42. As at 31 March 2015, APAS has commenced 81 projects, involving a project cost of $301 million. Among these projects, 39 (or 48%) are platform projects, 19 (or 23%) are collaborative projects, 15 (or 19%) are seed projects and 8 (or 10%) are projects under the PSTS.

43. In November 2012, APAS was merged into the Hong Kong Productivity Council (HKPC). After the merger, APAS has proactively capitalised on the wider network with the industry, with a significant improvement of its performance. The level of industry contribution has increased from 16.5% during the first five-year period from 2006 to 2011 to 37.6% in the four-year period from 2011 to 2015, which is the best among the five R&D Centres. This, in a way, demonstrated the confidence of APAS's industry sponsors in its technical competence and the good market potentials of its R&D results. Strategically, in the early days of APAS while the automotive parts industry was relatively small, APAS focused on platform projects to build up its know-how and capability. Towards the last few years when the demand for new automotive technology has increased and the industry become more

mature, there was a shift to more collaborative projects with more commercialisation ready deliverables.

44. Some significant R&D achievements of APAS are as follows –

(a) *"Made by Hong Kong" eBus* – APAS kicked off its largest collaborative project (with an ITF funding of around $20 million) for building the first "Made by Hong Kong" pure electric bus with local R&D capability. Two fully functional eBuses are designed by APAS and are now being assembled and underwent various types of testing and in the process of applying for Transport Department's relevant road permits. A local franchised bus operator and a number of municipal Governments in the Mainland have already expressed interests in undertaking trials for this bus; and

(b) *Electric Vehicles (EV) quick charger* – In 2014, APAS achieved a significant milestone with the completion of its 50kW EV charger development which can reduce the charging time of an average EV from 7-8 hours to about 20 minutes. The charger was also accredited by CHAdeMO, a key international charging standard used by approximately 70% of EVs, and is significantly cheaper than similar chargers from overseas. With funding from the PSTS, APAS has installed a version of the quick EV charger in the car park of Central Government's Offices at Tamar and Northern New Territories Police Headquarters. More trial systems are being planned in other locations (such as the Airport Authority premises). A major car distributor has already expressed interest in the range of EV chargers developed by HKPC and APAS.

Commercialisation and Technology Transfer to the Industry

45. In the four-year period from 2011 to 2015, APAS has signed 3 licensing agreements and received total commercialisation income of $0.9 million. APAS also filed 31 patents during these four years, and was granted 21 patents.

46. In recent years, APAS has put a stronger emphasis on collaborative projects so to forge tangible results and commercial outcome in the relatively new industry in Hong Kong.

47. Some selected examples of APAS's achievement on commercialisation are as follows –

(a) *Bus Infotainment System* – an SME in Hong Kong has successfully commercialised the Bus Infotainment System which is derived from the project deliverable of a platform project in 2009. The system has been deployed in over 150 buses in Thailand since 2012. In 2014, the Transport Department approved the system for installation in Guangdong-Hong Kong cross-boundary buses. Up to now, about 50 buses have been installed with the system and the sponsor expects to install it in over 200 buses; and

(b) *LCD Digital Dashboard* – in preparation for an increase in smart features and intelligence in next generation cars, APAS has developed a project for a full LCD digital dashboard to replace traditional analogue dials such as speedometer and tachometer. The sponsor of the project, an SME in Hong Kong, has successfully commercialised the project deliverable. Their dashboards, which are based on the technology developed in the ITF project have been sold for over 100,000 units and used in 8 different EV models from four car manufacturers in the Mainland.

Application of R&D Outcomes in the Public Sector and Benefits to the Community

48. Since the launch of the PSTS, APAS has been an active participant to showcase its R&D efforts to the community. From 2011 to 2015, APAS has conducted a total of 8 PSTS projects, which cover the areas of driver assistant system, charging station and vehicle infotainment system. It aims not only to bring new EV technologies into application but also to enhance the safety of the working environment.

49. Some significant achievements of APAS in the application of its Advanced Driver Assist System (ADAS) in the public sector are as follows –

(a) *Vehicle Safety* – the ADAS was installed in a total of 17 vehicles owned by the Neighbourhood Advice-Action Council, the Hong Kong Society for Rehabilitation, as well as Government departments such the Hong Kong Fire Service Department (HKFSD) and Water Supplies Department (WSD). This system provides imminent front-end collision, lane departure and vehicle-in-blind spot warning to drivers while they were on the road;

(b) *Construction Site Safety* – based on the technology developed in ADAS, APAS is conducting a trial project that aims to improve safety around large and heavy moving machineries in works sites of Government departments including Civil Engineering and Development Department, WSD, Drainage Services Department, and Architectural Services Department. The system will give warning signals to both the machine operator and surrounding personnel, hence improving safety in working environment; and

(c) *Light Rail Safety* – using the technology and knowhow developed in the ADAS, HKPC and APAS are conducting a pilot project for MTR Light Rail for giving advanced warning to the drivers for avoiding rear end collision. The pilot system has been installed on 5 Light Rail trains and is still undergoing field trial but the initial results are successful. HKPC and APAS are in discussion with MTR for further installing the system in over 150 trains of their fleet.

Other Key Developments

50. Since 2011-12, APAS has organised and participated in more than 30 promotional events and industry activities per year. APAS has also organised more than 250 promotional activities to foster knowledge exchange and business collaboration opportunities with industry partners and R&D institutions.

51. Over the years, APAS has developed valuable networking and relationship with trade associations, R&D institutions, professional organisations and industry partners. In April 2015, APAS organised the first Annual APAS Showcase which attracted over 200 industry participants, including speakers from major car manufacturers as well as leading academics from Tsinghua University.

52. APAS has also worked with Tongji University in Shanghai on technology related to the thermo-analysis of battery system and developed EV battery power pack design and verification technology together with Sun Yat-sun University in Guangzhou. In May 2015, APAS signed an Memorandum of Understanding (MoU) with the Tsinghua University to collaborate in EV development. APAS has also developed a close network and collaborative relationship with the automotive industries in the Mainland (such as a major Sino-Foreign Joint Venture automobile company) and overseas automotive industries. Internationally, APAS has actively searched for new

technologies that could be applied to the local industry. For example, it has identified a project on manufacturing process improvement by applying laser technology arising from a visit to Germany in 2014.

(B) ASTRI

53. ASTRI is a Government subvented organisation established in 2000. Its mission is to enhance Hong Kong's competitiveness in technology-based industries through applied research. For historical reasons, ASTRI is funded separately through Government's annual recurrent subvention.

R&D Achievements

54. As at 31 March 2015, ASTRI has commenced 337 projects, involving a total project cost of $2.6 billion. Among these projects, 164 (or 49%) are platform projects, 23 (or 7%) are collaborative projects, 143 (or 42%) are seed projects and 7 (or 2%) are projects under the PSTS.

55. In 2014-15, ASTRI has commenced a total of 44 projects which is 38% more than that of 2013-14 mainly due to the launch of a clustered-seed approach for ASTRI in early 2014 leading to commencement of 10 seed projects. Its level of industry contribution in 2014-15 is 21.6%, which marks a year-on-year improvement of 2.3 percentage points.

56. ASTRI has recently undertaken a reorganisation and identified four technologies for major pursuit, namely –

(a) *Financial Technologies (FinTech)* - ASTRI is mainly focusing on network security, big data analytics, and mobile platform technologies. Other research areas include crypto-processor, application of IoT in mobile payment, etc. ASTRI has also launched the ASTRI Security Laboratory (ASL) to share security information and to serve local financial institutes and the Government;

(b) *Intelligent Manufacturing Initiative (IMI)* – in view of the heavy investment of Hong Kong companies in the Pearl River Delta and alignment with national intelligent manufacturing strategy, which in part, reacts to continuous rising labour cost, ASTRI is developing new IMI technologies which combines its core competence in robotic vision, integrated power module packaging, big data analytics (e.g. predictive analysis) and communication to

transform the present labour intensive operation to information centric operation;

(c) *Next Generation Network (NGN)* - ASTRI is migrating its development efforts from 4G to 5G, focusing mainly small cell and core network software and IoT technologies, development and establishing of a NGN testbed, and applications platform which enables and supports various NGN applications (e.g. FinTech, IMI, etc). ASTRI has been actively participating in national 5G and IoT standardisation efforts; and

(d) *Medical and Health Initiative* - ASTRI is focusing on medical imaging, medical (e.g. endoscope and laryngoscope) and health electronics devices (e.g. non-invasive pulse oximeter and blood glucose measurement) and big data analytics. ASTRI also supports Government and NGOs on programs such as elderly care and community nurses.

It is hoped that R&D on these areas will bring upon greater impact to the community and help address the problem of sustainable development in Hong Kong and the Greater China region.

57. ASTRI also hosts the Hong Kong Branch of the Chinese National Engineering Research Centre (CNERC) dedicated for IC design. Over the next several years, ASTRI intends to develop several large scale R&D projects such as the Long-Term Evolution (LTE) based machine-to-machine (M2M) communication IC targeted for IoT applications and the exploration of an extendable multicore Central Processing Unit (CPU) which delivers high performance, reduce power consumption and is extendable.

Commercialisation and Technology Transfer to the Industry

58. In the four-year period from 2011 to 2015, ASTRI has signed 121 licensing agreements and received total commercialisation income of $96.2 million. ASTRI also filed 316 patents during these four years, and was granted 430 patents.

59. In order to create a bigger impact to our industry in commercialisation and technology transfer, ASTRI has recently introduced a new set of strategies –

(a) ASTRI has been actively pursuing collaborations with larger scale enterprises while keep on serving SMEs. With the introduction of

the initiatives on IMI and FinTech, ASTRI will engage a wider customer base including financial institutions;

(b) ASTRI has been seeking long-term partnership with strategic players in order to complement each other in R&D and commercialisation. For example, ASTRI has transferred a compact camera module related technology to an electronics company headquartered in the Hong Kong Science Park;

(c) ASTRI has strengthened training of talents and engaged in structured collaboration with academics and R&D organisations in Hong Kong, the Mainland and overseas through many different platforms, including the launch of the ASL in May 2015, the Hong Kong Branch of CNERC, ASTRI Innovation Runway, joint R&D labs (e.g. ASTRI-HP Information Technology Research Centre), consortia (e.g. Shenzhen-Hong Kong Microelectronics Consortium), etc.; and

(d) ASTRI will offer services to the industrial sectors in areas such as consulting and information sharing.

In future, ASTRI will continue to refine its strategies on R&D and commercialisation in view of the market and economic situation.

Application of R&D Outcomes in the Public Sector and Benefits to the Community

60. From 2011 to 2015, ASTRI launched a total of 7 PSTS projects and took part in 2 platform projects initiated by Government departments to promote the applications of R&D outcomes in the public sector and bring benefits to the local community.

61. The supporting Government departments and NGOs of these PSTS projects include Hong Kong Police Force (HKPF), Office of the Government Chief Information Officer (OGCIO), the Office of the Communications Authority (OFCA), Tung Wah Group of Hospitals (TWGHs), Education Bureau (EDB), and Hong Kong Housing Society (HKHS). Some relevant technologies include –

(a) wireless communications (collaborated with HKPF, OFCA and OGCIO);

(b) e-learning at schools (collaborated with EDB and HKPF); and

(c) health/elderly care (collaborated with HKHS and TWGHs).

Other Key Developments

62. In view that ASTRI had been in operation for over a decade, we have, in 2012-13, conducted a comprehensive review on the performance and mode of operation of ASTRI to identify any improvements required and recommend the way forward. For this purpose, a Review Committee comprising major stakeholders such as representatives from the industry and academia was set up to participate in the review exercise. The recommendations arising from Review are being implemented in stages. For instance, ASTRI's calculation method of the level of industry contribution has been aligned with that of other R&D Centres from 2013-14.

63. From 2011 to 2015, ASTRI has conducted a wide array of promotional activities such as –

(a) hosting the Industry University Collaboration Forum (IUCF) in Hong Kong and Shenzhen every year to solicit interests from industries and universities for collaborations in its new projects;

(b) organising seminars, corporate visits and signing ceremonies on various kinds of collaborations to promote ASTRI and its R&D outcomes; and

(c) actively participating in local and regional events such as InnoCarnival, ICT Expo, China Hi-Tech Fair, InnoDesign Tech Expo and interviews/meet-up with the media to promote its new innovations to the community and enhance public awareness.

64. ASTRI has also proactively reached out to its stakeholders in Hong Kong, the Mainland and overseas. For example –

(a) ASTRI has established 3 consortia to liaise with industrial companies for customer/partner engagement including Advanced Packaging Technology Consortium, and Digital Living Consortium and ASTRI Antenna Consortium;

(b) ASTRI has, in collaboration with Hong Kong Science and Technology Parks Corporation and Shenzhen Micro & Nano Institute, established the Shenzhen-Hong Kong Microelectronics Co-innovation Consortium in April 2015. This consortium aims

to provide an open platform micro-electronics industries, universities and research institutes to promote collaborations and share service resources; and

(c) ASTRI has been actively exploring partnership with companies and Government authorities in Hong Kong and the Mainland. Exhibitions/roadshows, conference/seminars/workshops and other publicities were conducted to promote ASTRI and the technologies developed. ASTRI also co-organised events with strategic partners to promote greater commercialisation in technologies.

(C) HKRITA

65. The mission of HKRITA is to be the leading centre of excellence in research, development and technology transfer in textile, apparel, and footwear technologies. The major technology focus areas of HKRITA include –

(a) new materials and textiles and apparel products;
(b) advanced textiles and clothing production technologies;
(c) innovative design and evaluation technologies; and
(d) enhanced industrial systems and infrastructure.

R&D Achievements

66. As at 31 March 2015, HKRITA has commenced 134 projects, involving a project cost of $388.4 million. Among these projects, 80 (or 60%) are platform projects, 23 (or 17%) are collaborative projects, 2 (or 1%) are seed projects and 29 (or 22%) are projects under the PSTS.

67. The performance of HKRITA from 2011 to 2015 has improved considerably. The Centre's overall level of industry contribution from 2011-12 to 2014-15 was 30.3%, which was substantially higher when compared to 12.4% during its first five-year period from 2006-07 to 2010-11. In 2014-15, HKRITA has commenced a total of 25 projects which is on par with 2013-14 and its level of industry contribution is 28.6%.

68. Since last year, a new feature of HKRITA is the growing number of internal or centre-owned projects. Previously, HKRITA had solely leveraged on external resources and partnered with other local researchers and institutions to conduct research projects. As HKRITA matures, it has found gaps in research activities, and issues with continuity due to the temporary nature of the academic research teams. In response, HKRITA has identified two domains

for building up cutting edge internal competencies to drive new and exciting projects –

(a) *Environmentally Friendly Technologies Domain* which deals primarily with the chemistry and engineering challenges of eliminating or reducing the use of water and energy in the manufacturing and care process of apparel and textiles as well as various novel recycling technologies; and

(b) *High Performance Materials Domain* which addresses the needs of athletics, elderly, various industries, and hospital patients.

Commercialisation and Technology Transfer to the Industry

69. In the four-year period from 2011 to 2015, HKRITA has signed 25 licensing agreement and received total commercialisation income of $3.3 million. HKRITA also filed 78 patents during these four years, and was granted 39 patents.

70. The Business Development team of HKRITA was established in September 2010 to promote and commercialise HKRITA's R&D project deliverables to the industry. The team has conducted different business activities to introduce project technologies to industries and foster commercialisation of technologies, through different promotion and networking channels.

71. Some selected examples of HKRITA's efforts in commercialisation /technology transfer include –

(a) *Finer Nu-Torque Cotton Yarn Production* - "Nu-torque" continues to be HKRITA's most productive technology; non-exclusive licences have been issued to 6 companies which generated over $8 million;

(b) *Advanced Clothing Functional Design (CAD) Technologies* - 5 non-exclusive licences have been issued to Guangdong Textile Polytechnic in the Mainland, a large fashion retailer in Canada, Shinshu University of Japan, Asahi Kasei Fibers Corporation LSO from Japan and Taiwan Textile Research Institute in Taiwan. Discussions with other interested companies are in process; and

(c) *Fabric Touch Tester (FTT)* - HKRITA has begun commercialisation of the hand touch FTT technologies in 2012-13. Market response

has been very positive, 6 units of the system were sold through its licensee. Furthermore, HKRITA has been working on with an international testing standard organisation to make the technology a benchmark and global standard for the industry.

Application of R&D Outcomes in the Public Sector and Benefits to the Community

72. HKRITA has been working with many different public organisations to get the most out of its research outcomes to benefit our society and community. From 2011 to 2015, HKRITA conducted a total of 29 projects under the PSTS. Some selected examples include –

(a) HKRITA has worked with the Hong Kong Sports Institute to design a high performance uniform for the Hong Kong Rowing Team to compete in the 2014 Asian Games in Korea;

(b) HKRITA has partnered with various Government departments like the HKFSD and the Marine Division of HKPF to work on their duty uniforms and extreme condition gear. These include heat management uniforms, and cooling and moisture management apparel systems; and

(c) HKRITA engaged NGOs such as TWGHs, the Hong Kong Jockey Club, and St James' Settlement to develop suitable textile based solutions for their work with the elderly, the sick, and the handicapped. These include RFID embedded tracking vests, impact resistant materials, and self-cleaning easy care fabrics.

73. In the future, HKRITA will continue its efforts in promoting the application of technology in the public sector, with focuses on elderly services and Hong Kong athletics who will take part in the 2016 Olympic Games.

Other Key Developments

74. Over the years, HKRITA has carried out a great variety of activities to promote its work and services to its stakeholders and the public. Some selected examples include –

(a) HKRITA's biennial Innovation and Technology Symposium has been well-received by industry leaders and other research institutes in the textiles-related disciplines. In 2011, the symposium took place in the Hong Kong Science Park, providing a broader platform

for technological exchange. In September 2013, HKRITA successfully organised the symposium at an international textile trade fair at the Hong Kong Convention and Exhibition Centre and had invited speakers and participation from international brands and retailers. The event attracted over 300 local and overseas attendees;

(b) HKRITA has signed MoU with key research institutions including Shinshu University of Japan, Deakin University of Australia, Australian Wool Innovation Limited, Cotton Incorporated of the United States, China Textile Academy, and Donghua University in Shanghai; and

(c) The International Exhibition of Inventions of Geneva is one of the most significant international invention events internationally. Over the years, HKRITA has won 16 medals, including 7 Gold medals from this event. At the 43rd International Exhibition of Inventions of Geneva that took place in April 2015, HKRITA won two gold medals and three silver medals.

(D) LSCM

75. The mission of LSCM is to foster the development of core competencies in logistics and supply chain related technologies and to facilitate the adoption of these technologies by industries in Hong Kong and the Mainland.

76. The major technology focus areas of LSCM include –

(a) Infrastructure Information Technology System;
(b) IoT and RFID Technology;
(c) Location-based Service (LBS) Technology;
(d) Logistics and Supply Chain Analytics and Applications; and
(e) Supply Chain Security.

R&D Achievements

77. LSCM is committed to playing a pivotal role to promote innovation and adoption of technologies in both public and private sectors.

78. As a result of its continuous effort, the performance of LSCM from 2011 to 2015 has improved considerably –

(a) the number of new projects commenced increased from 29 during 2006-2011 (5 years) to 48 during 2011 to 2015 (4 years);

(b) overall level of industry contribution from 2011-12 to 2014-15 was 23.5%, which was significantly higher compared to the 12.3% of industry contribution during its first five-year period (from 2006 to 2011);

(c) increased number of collaborative research projects from 2 projects involving a total of $4 million during 2006-2011 to 7 projects involving a total of $19 million during 2011-15, which represents an increase by 250% and 375% in project number and project cost respectively; and

(d) 42 licensing agreements were signed, compared with only one licensing agreement signed during the first five-year period.

79. As at 31 March 2015, LSCM has commenced 77 projects, involving a project cost of $436 million. Among these projects, 42 (or 54%) are platform projects, 9 (or 12%) are collaborative projects, 2 (or 3%) are seed projects and 24 (or 31%) are projects under the PSTS.

80. It has sustained its healthy growth rate in 2014-15 by commencing 17 new projects in 2014-15, which represents an increase of 31% as compared with 2013-14. It also achieved an industry contribution level of 31.4% in 2014-15, which is the highest level since the establishment of the Centre in 2006.

81. In the previous few years, LSCM was also keen to build up its technological capability in focused areas. For instance, LBS technologies have emerged as a key enabling technology for positioning, tracking, or other personalised applications. In order to improve the competitiveness of local industry by harnessing the applications of LBS, LSCM has, in collaboration with more than 10 professors from six local universities, initiated multiple projects to advance the state of the art, including both indoor and outdoor navigation, Wi-Fi, cellular, and satellite-based approaches, active and passive RFID positioning, etc.

82. As a result of LSCM's efforts to supporting local adoption of its technological offerings, a local private hospital has adopted LSCM's Babytag and monitoring system in its new infant ward; Hong Kong International Airport has participated in the pilot use of Wi-Fi-based navigation and novel indoor GPS system; and the Air Mail Centre of Hongkong Post has commissioned the

use of an active RFID positioning platform to track its parcel carts in its cargo handling centre.

Commercialisation and Technology Transfer to the Industry

83. In the four-year period from 2011 to 2015, LSCM signed 42 licensing agreement and received a total commercialisation income of $0.9 million. LSCM also filed 22 patents during these four years.

84. With strong support from the Board of Directors, LSCM has initiated a strategic commercialisation plan in order to facilitate the effective transfer of the Centre's technologies to both the private and public sectors. Over the past few years, LSCM has exerted a greater focus in identifying and developing industrial potential and business opportunities derived from its technologies.

85. These efforts have produced encouraging results in the adoption of LSCM's technologies. In 2014, LSCM developed and showcased its tamper-resistant and reusable Babytag technology in a local hospital, which subsequently attracted the interest of two local companies, each of which have since licensed the Babytag technologies in order to support their business expansion for infant tracking solutions in the Hong Kong and the Mainland markets. One of these companies has been further awarded a contract to provide the baby tracking system to a local private hospital.

86. LSCM has promoted the commercialisation of its RFID Reader IC Chip design by partnering with a local RFID company through a collaborative project to productise the chip and push its adoption into the marketplace. LSCM also created industry-driven applications for the RFID reader by utilising LSCM chip as a backbone for developing PSTS projects. So far, 4 PSTS projects have been launched in connection with the RFID reader –

(a) Reader for Airport Home Printed Luggage Tags;
(b) Tree Reader for Hong Kong Housing Authority;
(c) Walking cane with embedded RFID reader for Hong Kong Society for the Blind; and
(d) Multi-purpose reader for smart community care applications.

Application of R&D Outcomes in the Public Sector and Benefits to the Community

87. With the support of more than 40 Government bureaux/departments, public bodies, and industry/trade associations, LSCM has commenced work on a total of 24 PSTS projects since its establishment.

88. In the future, with a sustainable growth strategy in place, LSCM has great potential for fostering more collaboration opportunities with the public sector and transferring R&D results to the private sector.

Other Key Developments

89. LSCM has been actively involved in promotional activities in order to increase awareness of its capabilities to various sectors and industries in Hong Kong. In 2013-14, LSCM was appointed an institutional member of the Hong Kong Logistics Development Council (LOGSCOUNCIL) in recognition of its knowledge and expertise in the logistics industry.

90. Apart from serving in LOGSCOUNCIL, LSCM also serves as a member of Airport Authority Hong Kong's Technology Advisory Council, Construction Industry Council's Task Group on Application of Innovative Design to Enhance Construction Safety; and the Logistics Advisory Committee of the Hong Kong Trade Development Council.

91. An increasing awareness of LSCM is demonstrated by feedbacks from a series of LSCM's events including LSCM Logistics Summits (2012, 2013 and 2014) and the LSCM Logistics Roadshows (February 2013 and 2014, and April 2015). As a result, LSCM has forged partnerships with many new industry partners.

(E) NAMI

92. The mission of NAMI is to serve as Hong Kong's platform for technology development in the areas of advanced materials and nanotechnology. In particular, NAMI will –

(a) identify and conduct innovative, market-driven R&D projects in collaboration with the local industry and research community; and

(b) drive the commercialisation of R&D outcomes.

R&D Achievements

93. Recently, NAMI has undertaken a significant paradigm shift on R&D with stronger emphasis on conducting demand-driven collaborative projects in partnership with local enterprises. It aims at increasing the adoption of NAMI's technologies and R&D outcomes by proactively reaching out to industries to develop and implement more market-driven projects.

94. Some selected achievements of NAMI in recent years include -

(a) commenced a larger number of projects, including contract research, which increased from 24 projects for $27.3 million in 2013-14 to 63 projects for $101.6 million in 2014-15. The increase in project cost is 272%;

(b) increased industry sponsorship received by NAMI for the above-mentioned projects from $5.2 million in 2013-2014 to $32.8 million in 2014-15, representing an increase by 531%;

(c) increased contract research projects from 8 projects for $1.3 million in 2013-14 to 22 projects for $13.2 million in 2014-15. The contract research projects are mainly aimed to develop new functional materials in order to provide technology upgrade to local industries;

(d) collaborated on a number of new projects with 43 local industrial companies in 2014-15, as compared to 15 local companies in 2013-14. The 43 local companies include 3 listed companies and 40 SMEs in Hong Kong; and

(e) obtained $0.9 million licensing income in 2014-15 as compared with $32,000 in 2013-14, by leveraging intellectual properties created in previous projects.

95. As at 31 March 2015, NAMI has commenced 139 ITF projects, involving a project cost of $473.3 million. Among these projects, 36 (or 26%) are platform projects, 49 (or 35%) are collaborative projects, 46 (or 33%) are seed projects and 8 (or 6%) are projects under the PSTS.

96. The performance of NAMI from 2011 to 2015 remained strong. Its overall level of industry contribution for ITF projects from 2011-12 to 2014-15 was 31.0%, which was on par with the 31.2% achieved in its first five-year period from 2006 to 2011. In 2014-15, NAMI commenced a total of 41 ITF projects, which represents a very significant increase by 156% from the 16 projects in 2013-14.

97. Over the past few years, NAMI has developed strong core competencies on nanotechnology and advanced materials. It won several awards in 2014, including the Federation of Hong Kong Industries' the "Hong Kong Awards for Industries Technological Achievement Award" for its Die Attach Adhesive (DAA) technology, and Environmental Campaign Committee's

Hong Kong Awards for Environmental Excellence Certificate of Merit for its Foam Concrete technology.

Commercialisation and Technology Transfer to the Industry

98. In the four-year period from 2011 to 2015, NAMI signed 19 licensing agreements and received total commercialisation income of $17.4 million. This compared favorably to the performance in the five-year period from 2006 to 2011, when there were only 4 signed licensing agreements, with commercialisation income of $2.73 million. NAMI also filed 287 patents within these four years. More commercialisation income is expected from commenced projects in the coming years.

99. In 2014-15, NAMI granted a total of 8 technology licences, including 2 licences on NAMI's technologies on water-based environmentally friendly paint and photocatalytic oxidation technology. The former technology was licensed to a coating manufacturer for a special coating application and the latter was adopted by an indoor air quality equipment supplier to improve performance of their air purification system. The remaining 6 licences were related to the following background IP –

(a) DAA to improve thermal management of plasma lighting;
(b) Printable temperature sensor technology to develop semi-conductor nano-inks for Thin Film Transistor backplane as well as a flexible, thin, waterproof and low cost temperature sensor;
(c) Foam concrete technology to develop light-weight hydrophobic cementitious sound barrier;
(d) Nano-calcium polymer technology to develop injectable calcium phosphate filler formulation for use as bone substitute in treating osteoarthritis cysts; and
(e) All-solution-processed metal oxide semiconductor technology to develop next generation thin film transistor.

Application of R&D Outcomes in the Public Sector and Benefits to the Community

100. NAMI has been taking an active role in promoting the application of R&D outcomes in the public sector. From 2011 to 2015, NAMI conducted a total of 8 projects under the PSTS. For example –

(a) NAMI has applied a germicide-free and durable antibacterial coating in a public hospital. Test results showed that the lifetime of the coating was at least 9 months without the need of

replenishment after initial coating. In order to further extend the application of the coating, it has been applied to door handles at designated washrooms in the Hong Kong Science Park; and

(b) NAMI's nano-patch for the topical treatment of limb injuries has been applied to patients with soft-tissue or bone injuries in Hong Kong Polytechnic University's (PolyU) Sports Rehabilitation Centre. The technology has been used as background IP by industry sponsors for development of other healthcare products.

Other Key Developments

101. NAMI has increased the scope and intensity in promoting its technology competencies, research outcomes and commercialisation achievements. These included organising and participating in seminars, conferences, workshops, trade shows, etc. The NAMI Showcase held in 2013 and 2014 respectively received very good response from its collaborating partners, local research institutes and enterprises as well as the public, and had brought about many new collaborating opportunities. NAMI has also enhanced the dissemination of NAMI's technological development and ready-to-market technologies through a revamped website, new corporate video, product videos, regular press advertorials, etc.

102. NAMI has been in active collaboration with local universities and overseas research centres on various development projects and create synergy in research and developing talents. On R&D collaboration, while NAMI encourages local universities to apply research projects in advanced materials for funding support, NAMI also collaborate with local universities to jointly work on research projects. For example, NAMI is working with PolyU on a project about the design and development of highly hydrophobic conduits with riblet surface for sustainable urban drainage system. In another project, NAMI is working with the Hong Kong University of Science and Technology (HKUST) to develop new materials and green process for performance improvement in Nickel Manganese Cobalt Oxide-based lithium-ion battery. Furthermore, professors from PolyU, HKUST, City University of Hong Kong and Chinese University of Hong Kong are invited to be NAMI's technical advisors to support its technology development.

103. NAMI also looks for leading research institute overseas and in the Mainland to support its research excellence through partnering. NAMI is now working closely with Fraunhofer Institute for Silicate Research ISC, the leading German applied R&D institute in material science, to develop research collaboration to support Hong Kong industries. Besides, NAMI has also

established collaboration agreements with two leading research institutes in the Mainland, namely the China Building Materials Academy and the Chinese National Engineering Research Center of Urban Environmental Pollution Control.

PART C - PROPOSED EXTENSION OF THE R&D CENTRES TO 31 MARCH 2021

104. Among the five R&D Centres, the operating expenditure of four of them, namely APAS, HKRITA, LSCM and NAMI, is funded by the ITF while the operating expenditure of ASTRI is funded separately from Government's annual recurrent subvention due to historical reason.

(A) Additional Funding for R&D Centres

105. As mentioned in paragraph 7, the FC has approved a total funding commitment of $1,019 million to support the operating expenditure of the four R&D Centres up to 31 March 2017. As showed at Table 8 above, as at 31 March 2015, the four R&D Centres funded by the ITF (APAS, HKRITA, LSCM and NAMI) have incurred a total of $675.3 million in operating expenditure and the remaining funding commitment is $343.7 million.

106. Having considered the satisfactory performance of the four R&D Centres, we have analysed their future business plans and funding requirements for their operation beyond 31 March 2017. As the R&D Centres have shown sustained improvements in their overall performance and their continued operation would be conducive to promoting innovation and technology upgrading in their respective industrial sectors, **we propose to extend their operation for four more years until 31 March 2021. This will involve an additional funding commitment from the ITF of $677.6 million for the four R&D Centres funded by the ITF (except ASTRI)**.

107. The proposed extension will enable the R&D Centres to continue with their work and enter into longer term collaborative agreements with their partners and other R&D Centres so as to map out their long-term goals and directions. This will also enable them to continue their concerted efforts in applying technologies to the benefits of the community, such as those improving the livelihood of the elderly or other sectors such as construction. The detailed funding proposal is set out below.

APAS

Funding Already Approved –

	(in $ million)
Funding commitment approved by FC in June 2005, June 2009, May 2012 for APAS's operation from 1 April 2006 to 31 March 2017	228.2
Note: Actual expenditure of APAS for the first 9 years (1 April 2006 – 31 March 2015)	*130.8*

Additional Funding Proposed –

	(in $ million)
Proposed additional funding for extending APAS's operation for four further years (up to 31 March 2021)	71.5
i.e. Proposed total funding commitment for APAS for a 15-year period (1 April 2006 – 31 March 2021)	***299.7 [average annual expenditure: $20.0 million]***

Highlights of Future Development

108. In terms of number of projects, we expect that the annual figure will gradually increase by 12% annually to about 32 annually in 2020-21. The indicative R&D expenditure for 2017-18 to 2020-21 is $385 million, which represents an annual expenditure of about $96 million or an annual increase of 12%.

109. The strong market demand for EVs, smart technologies and the huge 70 million cars per year market in the Mainland present favourable business opportunities for the local industry for the next few years. To capitalise on this trend, APAS developed a market-led technology roadmap to help local industry upgrade and transform their technical and production capability, with particular focus on SMEs in Hong Kong. So far, APAS has already attracted many companies to work on new projects in smart and specialised industrial EVs. Leveraging technology partnership with leading R&D institutes in Hong Kong, the Mainland and overseas, APAS expects to serve Hong Kong industry with practical technology support for meeting the vast market demand in the coming years.

110. Details of the future plan of APAS and the corresponding estimated funding requirement are at **Annex A**.

HKRITA

Funding Already Approved –

	(in $ million)
Funding commitment approved by FC in June 2005, June 2009 and January 2014 for HKRITA's operation from 1 April 2006 to 31 March 2017	197.7
Note: Actual expenditure of HKRITA for the first 9 years (1 April 2006 – 31 March 2015)	*127.3*

Additional Funding Proposed –

	(in $ million)
Proposed additional funding for extending HKRITA's operation for four further years (up to 31 March 2021)	146.8
i.e. Proposed total funding commitment for HKRITA for a 15-year period (1 April 2006 – 31 March 2021)	***344.5 [average annual expenditure: $23.0 million]***

Highlights of Future Development

111. In terms of number of projects, we expect that the annual figure will gradually increase by 6% annually to about 40 annually in 2020-21. The indicative R&D expenditure for 2017-18 to 2020-21 is $392 million, which represents an annual expenditure of about $98 million or an annual increase of 7%.

112. At present, Hong Kong's textiles and apparel industry is transforming from manufacturing to innovation as many of the manufacturing operations have been relocated from the Pearl River Delta to other developing economies. Capitalising on this trend, HKRITA considers that its key competitive opportunities are in the areas of high performance materials (for sports, industrial, and health applications), wearable electronics, green materials, sustainable manufacturing, and agile supply chains.

113. Using the 2020 as a goal post, HKRITA aims to work on high performance materials and smart systems to enhance performance and impact protection, improve comfort, and enable wearable health monitoring. These have applications for sports, healthy active living, and elderly care. As sustainability is also a key theme for HKRITA, it will develop new materials that are non-toxic, less energy intensive, and recyclable. HKRITA will also work on clean manufacturing processes that produce less pollution and use less resource.

114. Details of the future plan of HKRITA and the corresponding estimated funding requirement are at **Annex C**.

LSCM

Funding Already Approved –

	(in $ million)
Funding commitment approved by FC in June 2005, June 2009, May 2012 and January 2014 for LSCM's operation from 1 April 2006 to 31 March 2017	207.9
Note: Actual expenditure of LSCM for the first 9 years (1 April 2006 – 31 March 2015)	*149.5*

Additional Funding Proposed –

	(in $ million)
Proposed additional funding for extending LSCM's operation for four further years (up to 31 March 2021)	154.5
i.e. Proposed total funding commitment for LSCM for a 15-year period (1 April 2006 – 31 March 2021)	***362.4 [average annual expenditure: $24.2 million]***

Highlights of Future Development

115. In terms of number of projects, we expect that the annual figure will gradually increase by 9% annually to about 30 annually in 2020-21. The indicative R&D expenditure for 2017-18 to 2020-21 is $313 million, which represents an average annual expenditure of about $78 million or an annual increase of 8%.

116. The booming of e-Commerce and the advent of China's "Belt and Road Initiative" and "Internet Plus" strategy have created huge demands for continued advances in new logistics and supply chain technologies. As one of the leading logistics hubs in the region, e-Commerce and logistics industries of Hong Kong are well positioned to capitalise on the coming wave of innovation-driven opportunities.

117. Looking forward, LSCM's research will continue to make a positive impact on the long term sustainability and growth of local industries. By leveraging LSCM unique position as a liaison among the Government, industry, academia and research institutions, LSCM has positioned itself to take on an active role in supporting both Government's policy and industry-driven

initiatives, including Smart City, Supply Chain Security, Smart Warehouse and Logistics with Robotics Technology, and e-Commerce advancement, such as e-logistics, e-payment and e-fulfillment, etc.

118. Details of the future plan of LSCM and the corresponding estimated funding requirement are at **Annex D**.

NAMI

Funding Already Approved –

	(in $ million)
Funding commitment approved by FC in June 2005, June 2009 and May 2012 for NAMI's operation from 1 April 2006 to 31 March 2017	385.2
Note: Actual expenditure of NAMI for the first 9 years (1 April 2006 – 31 March 2015)	*267.7*

Additional Funding Proposed –

	(in $ million)
Proposed additional funding for extending NAMI's operation for four further years (up to 31 March 2021)	304.8
i.e. Proposed total funding commitment for NAMI for a 15-year period (1 April 2006 – 31 March 2021)	***690.0 [average annual expenditure: $46.0 million]***

Highlights of Future Development

119. In terms of number of projects, we expect that the figure will gradually increase by around 5% per year to about 68 in 2020-21. The indicative R&D expenditure in the four-year period from 2017-18 to 2020-21 is $580 million, which represents an average annual expenditure of about $145 million or an annual increase of around 7%.

120. As industries around the world develop, the demand of smart materials for new products goes up significantly. The ability to study and develop materials at the nanoscale will lead to a revolution in technology and manufacturing, and will help industries sustain its global competitive advantages. Many developed economies including the United States and the Mainland have substantially increased their investment in advanced materials and nanotechnology over the last decade. The potential opportunities and benefits of nanotechnology are huge.

121. NAMI has learned that Hong Kong industries view advanced materials and nanotechnology as major drivers of innovation. In 2014-15, NAMI significantly increased its R&D collaboration across all five market sectors with local industrial companies, which regard NAMI as their materials expert. By implementing these collaborative projects focused on advanced materials, NAMI's researchers manoeuver matter on a nanoscale in its laboratories to engineer a vast array of innovative, next-generation applications never envisioned before to benefit Hong Kong industries.

122. By collaborating with local industrial companies, leveraging overseas research experts, and teaming with Hong Kong university professors, NAMI is positioned to become the leading research institute on advanced materials and nanotechnology in Hong Kong.

123. Details of the future plan of NAMI and the corresponding estimated funding requirement are at **Annex E**.

[Note: For ASTRI, after considering its historical background, including its institutional set up, we consider it appropriate to continue to fund the operation of this R&D Centre through recurrent Government subvention. As such, there is no need to seek additional funding from FC in the coming exercise. However, despite the different funding arrangement for operating expenditure, ASTRI will be subject to the same mechanism of performance monitoring, expected to meet the same industry contribution target, etc.]

(B) Performance monitoring

Level of Industry Contribution

124. As the R&D Centres have already achieved the industry contribution target of 20% in the four-year period from 2011-12 to 2014-15 and are gradually building up stronger client base and industry reputation, we are optimistic that their performance in industry collaboration will continue to improve.

125. For the coming years until 2020-21, we suggest that the same industry contribution target of 20% to apply. This should give the Centres sufficient incentive to proactively reach out to the industry and solicit sufficient sponsorship to focus on industry-driven and market relevant R&D, while allowing flexibility for individual Centres to undertake platform projects (which require a minimum of 10% sponsorship only) to continue to build up their technical expertise and capabilities, and for transfer to the industry subsequently

through collaborative projects and contract research. We will however revisit this target again in three years' time and consider whether it should be further adjusted.

Commercialisation

126. In the coming few years, all the R&D Centres will step up their efforts in driving commercialisation of R&D outcomes, following the completion of an increasing number of R&D projects.

127. We note that the number of licensing deals and commercialisation income received by the R&D Centres have started to increase gradually. These included income generated from licensing fees, royalty and contract services. For details of the commercialisation income of the Centres, please refer to **Annex A** to **Annex E**. We however are mindful that such income still only constituted a small proportion of their total industry income and could fluctuate significantly due to a number of factors such as the economic situations, market reactions and technological developments. We would continue to monitor closely the progress of commercialisation of the Centres and review again whether to set other relevant performance indicators on commercialisation having regard to the development of the Centres by then.

128. Indeed, as arising from a comprehensive review of the ITF which was completed in November 2014, we have introduced a series of enhancement measures to promote commercialisation (as well as realisation) and application of R&D outcomes. For example, we have –

(a) extended the funding scope of the ITF to downstream R&D and commercialisation activities, allowing better exploitation of the technological edge of local industries;

(b) raised the funding ceiling for the PSTS to up to 100% of the actual cost of the original R&D project supported by the ITF to promote the application of R&D outcomes in the public sector;

(c) waived the industry sponsorship requirement for the ITSP platform projects initiated by Government departments;

(d) promulgated a new "Guide on IP Arrangements for R&D Projects Funded under the ITSP" (IP Guide) which gives greater flexibility to R&D Centres and research institutions to negotiate with their collaboration partners the suitable IP arrangement, including IP ownership, licensing and benefit sharing; and

(e) launched a comprehensive/systematic post-project evaluation framework to better assess and monitor the outcome and commercialisation of projects conducted by R&D Centres as well as the performance of the project teams.

Cost Effectiveness

129. We recognise that the total operating expenditure of the R&D Centres still constitute a sizeable proportion of their annual R&D expenditure. We have critically reviewed the expenditures of the R&D Centres and consider them generally reasonable as the Centres have been supporting a wide range of activities including conducting basic research to build up their technological capability and determine their future R&D focuses, identifying potential industry clients and research partners for future collaboration, commercialisation and marketing efforts at the corporate level, etc.

130. While we expect their operating expenditure to increase gradually in the coming few years to commensurate with the increased number of R&D projects and commercialisation efforts, we anticipate that their cost-effectiveness should improve particularly as more licensing deals arising from completed R&D projects could be closed.

Review and Control Mechanism

131. We will continue to monitor closely the operation and performance of the R&D Centres. As a standard practice, they are required to prepare and submit the following for approval by their respective Boards of Directors and the ITC every year –

(a) an annual plan on the Centre's R&D programme, including the annual expenditure budget and performance indicators;

(b) quarterly reports on their operation, covering the staffing position, major activities and expenditure position; and

(c) annual audited accounts of the Centre's operation and its R&D projects.

In addition, we will continue to submit the Centres' progress reports to the Panel annually.

(C) Expected Benefits

132. We consider that the R&D Centres have contributed to the development of innovation and technology in Hong Kong since their establishment and particularly in the past four years –

(a) the four R&D Centres funded by the ITF have conducted more applied R&D projects in their respective focus areas, with their total R&D expenditure rising from $417 million in the first five-year period (from 2006 to 2011) to $600 million in the previous four-year period (from 2011 to 2015);

(b) the R&D Centres have been performing satisfactorily in serving as focal point to facilitate collaboration among the Government, industry, academia and research sectors in R&D and application of technology in their respective focus areas in the industry as well as the community;

(c) the R&D Centres have been able to encourage greater industry participation in conducting applied R&D in Hong Kong, e.g. the continued improvement of their level of industry contribution as well as the significant increase in the number of collaborative projects in the past four years;

(d) the R&D Centres have been providing more training and employment opportunities for universities graduates and technical personnel. For example, in 2014-15, the four R&D Centres have engaged a total of about 1200 R&D personnel in their R&D projects; and

(e) the R&D Centres have been able to strengthen their links with various stakeholders, e.g. companies, trade associations, academia, etc. through various channels like seminars, exhibitions, etc. both locally and overseas.

133. We expect that the R&D Centres will continue with their current efforts and step up their collaboration with stakeholders to support the industry and bring wider benefits to the community as a whole. For further details on the development plans of the R&D Centres and the expected benefits to be brought to the industry and community, please refer to **Annex A** to **Annex E**.

FINANCIAL IMPLICATIONS

Operating Expenditure

134. **It is estimated that an additional grant of $677.6 million, over and above the $1,019 million already approved by the FC, is required from the ITF**. The indicative breakdown of the proposed additional allocation is as follows –

Table 12: Operating Expenditure ($ million)

	Estimated Remaining Funding Commitment as at 31 March 2017	2017-18	2018-19	2019-20	2020-21	Proposed Total Additional Funding Commitment
APAS	54.6	27.3	29.9	32.8	36.1	71.5
HKRITA	7.1	35.1	37.0	39.6	42.2	146.8
LSCM	0	34.3	36.8	39.8	43.6	154.5
NAMI	0	66.2	74.4	80.4	83.8	304.8
Total	**61.7**	**162.9**	**178.1**	**192.6**	**205.7**	**677.6**

R&D Project Expenditure

135. The R&D expenditure of the R&D Centres will be funded separately out of the ITF on a project basis. The latest estimates of the R&D expenditure of the R&D Centres (detailed breakdowns at **Annex A to Annex E**) are summarised below –

Table 13: R&D Expenditure ($ million)

	Actual R&D Expenditure		Indicative R&D Expenditure	
	First Five Years of Operation (2006-11)	Four-year Period (2011-15)	2015-17	2017-21
APAS	89.9	92.6	121.0	385.0
HKRITA	98.0	157.6	160.0	392.0
LSCM	139.4	164.1	114.8	313.3
NAMI	89.5	185.8	205.0	580.0
Total	**416.8**	**600.1**	**600.8**	**1,670.3**

136. The total estimated additional funding requirements for the operating expenditure of the R&D Centres from 2017-18 to 2020-21 and their estimated R&D expenditure will be met by the uncommitted balance of the ITF[1].

ADVICE SOUGHT

137. Members are invited to note the latest progress of the R&D Centres and the findings of the comprehensive review of the R&D Centres at Part A and Part B of this paper as well as to offer views on the proposed extension and funding proposal at Part C. Subject to Members' support, we will submit the funding proposal to FC for approval in due course.

Innovation and Technology Commission
June 2015

[1] The LegCo FC approved on 27 February 2015 a further injection of $5 billion into the ITF to provide sustained and comprehensive support for the development of innovation and technology in Hong Kong.

Annex A

Comprehensive Review on R&D Centres 2015

Automotive Parts and Accessory Systems R&D Centre (APAS)

A video featuring selected achievements of APAS is available at the following link –

https://www.youtube.com/watch?v=3536DfcWs9Y

PART 1 – HIGHLIGHT OF OPERATION IN 2014-15

I. New R&D Projects and Industry Contribution (in $million)

	2013-14			2014-15		
	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution
Platform	2	10.8	2.0 (18.5%)	4	12.5	1.7 (15.4%)
Collaborative	7	70.2	33.0 (47.0%)	3	20.6	10.4 (50.5%)
Seed	1	2.7	n/a	1	2.6	n/a
Total:	10	83.7	35.0 (41.8%)	8	35.7	12.1 (35.2%)
Public Sector Trial Scheme	4	3.3	n/a	-	-	n/a

Note: *Figures in brackets denote the level of industry contribution.*

II. Operating Expenditure (in $million)

	2013-14	2014-15
Staffing	8.2	9.6
Accommodation	1.4	2.0
Equipment	0.1	0.2
Others	1.7	2.0
Total:	11.4	13.8

III. Industry Income Received (in $million)

	2013-14	2014-15
Sponsorship for projects	8.24	16.25
Licensing/Royalty	0.01	-
Contract Services	0.16	0.20
Others	0.05	0.05
Total:	8.46	16.50

PART 2 – GENERAL BACKGROUND

1. Mission and vision

Vision

To become a leading automotive parts and accessory systems R&D centre in the region and assist Hong Kong's foundation industries to enter into or expand in the automotive market. The 3 major focus areas of APAS' technology roadmap include –

(a) green transportation;
(b) smart mobility; and
(c) materials and manufacturing.

Mission

(a) Develop R&D competencies in selected core technical areas;
(b) Establish related networks in the Mainland and overseas;
(c) Collaborate with the Mainland and overseas R&D partners; and
(d) Promote R&D services and expand user base.

2. Institutional set up

APAS was established in 2006 as a subsidiary company of the hosting organisation, the Hong Kong Productivity Council (HKPC). On 1 November 2012, APAS was merged with HKPC as a new internal division of HKPC. HKPC oversees the operation and development of the APAS division.

Internal Audit (IA) mechanism continues to be put in place and IA reports are submitted to the HKPC Audit Committee. The APAS division is required to prepare annual plans, mid-term reports and annual reports on its operation and submit them to the Commissioner for Innovation and Technology (CIT) for approval.

3. Organisation

As at 31 March 2015, the staff strength of APAS is 29, against an establishment of 33 posts including the General Manager. An organisation chart is at Appendix.

PART 3 – EVALUATION OF THE PERFORMANCE OF THE R&D CENTRE FROM 2011-12 TO 2014-15

1. R&D Achievements

Comparing to its first five years of operation, the performance of APAS in last four years has improved both in its solicitation of industry contribution and the conduct of more collaborative projects. During the four-year period, the centre achieved an overall industry contribution level of 37.6% verse to the original target of 20%. In the same period, the total pledged industry contribution on approved projects amounted to $52.6M (doubled that of $25.4M in the first 5 years). APAS also extended its focus on developing collaborative project. The total collaborative projects grew from 6 in first five years to 13 in 2011-12 to 2014-15, an increment of 117%.

APAS has strong R&D achievements in its focus technical areas of electric vehicles (EV) and smart technologies based on the technology roadmap defined in 2010 and updated in 2014. A summary of some significant R&D achievements is as follows –

a) **EV Quick Charger** – In 2014, APAS achieved a significant milestone with the completion of the 50kw EV charger development. The charger was accredited by CHAdeMO, a key international charging standard used by approximately 70% of EVs. The accreditation is the first of its kind in the Mainland and Hong Kong. The charger can reduce the charging time of an EV sedan from 7-8 hours to about 20 minutes.

b) "**Made by Hong Kong" eBus** – APAS kicked off its largest collaborative project for building the first 'Made by Hong Kong' electric bus with local R&D capability. The light-weighted structure and powertrain have been developed and integrated. The test run already started in February 2015.

c) **New Generation Battery Management System (BMS)** – After years of research and development, APAS has developed the core knowhow in BMS, a key competence in the development of EVs and gained recognition from industry and vehicle manufacturers. The developed BMS helped an EV to increase its driving range yet reducing the weight of the battery.

Number of patents – Over the years, APAS has filed 46 patent applications including 31 patents filed during the last four years. The total number of patents granted has grown to 23 comparing to just 2 for the first five years. The intellectual property of the centre has been greatly strengthened and improved during the period.

2. Commercialisation and Technology Transfer to the Industry

Commercial Deployment

In commercialisation and technology transfer, APAS has put a strong emphasis on collaborative projects to forge tangible results and commercial outcome in the relatively new industry in Hong Kong. The summary below shows the R&D outcomes with their commercial applications by SMEs, companies and the public sector in Hong Kong –

a) **MOST150 Bus Infotainment System** – Starting as a sponsor for the MOST150 platform project, an SME in Hong Kong has successfully commercialised the system and has it deployed in over 150 buses in Thailand. In 2014, approval was obtained from the Transport Department in Hong Kong to have the system installed in Guangdong-Hong Kong cross-boundary buses. The sponsor expects to have over 200 buses installed with the system.

b) **LCD Digital Dashboard** – In preparation for the increase in features and intelligence in the next generation of cars, APAS has developed a flexible full LCD digital dashboard under a platform project. Its sponsor is successful in commercialising the dashboard that is now used by a major Mainland car manufacturer in its car production.

c) **Fast EV Chargers** – After the merger with HKPC in 2012, APAS has a full portfolio of EV chargers from low cost medium speed chargers, originally developed by HKPC, to the more advanced quick chargers developed by APAS. The chargers have attracted a lot of interests from the industry for deployment in Hong Kong and the Mainland.

d) **Over-moulding Tandem Injection Moulding Machine** – After the completion of the collaborative project in 2014, the industry partner has continued its commercialisation efforts. The technology is now being evaluated by a number of interested auto parts manufacturers for possible adoption in their production.

Technology Licensing

a) **Wireless Backup monitoring system** – the R&D result of ‘Wireless Back UP monitoring system’, a seed project, gained good industry interest at one of the promotional events and was successfully licensed by a local company for development.

b) **Hardening Technology** – Although APAS mainly focuses on automotive industry, its technology also found its application in another industry. The engine ring hardening technology developed by APAS was licensed to a local watch company to enhance the surface property of its products.

c) **LED Headlamp** – The technology developed in a platform project was licensed by a local SME for potential applications in motorcycle headlamp application.

3. Application of R&D Outcomes in the Public Sector and Benefits to the Community

Since the inception of Public Sector Trial Scheme (PSTS), APAS has been an active participant to showcase our R&D efforts to the community. During the period, the centre conducted 8 trial projects. These projects cover the areas of driver assistant system, charging station and vehicle infotainment system. APAS aims to bring not only new EV technology but also safer working environment. The following shows a summary of key public sector trials and their benefits –

a) **Trial of Advanced Driver Aid System (ADAS)** – The ADAS was installed in a number of vehicles owned by the Hong Kong Police Force, the Fire Service Department, Water Supplies Department as well as the Hong Kong Society for Rehabilitation. The system trialled in this project gave imminent front-end collision, lane departure and vehicle-in-blind spot warning to drivers while they were on the road. This project gave participating organisations the use of new driver aid technology for the improvement to safety and a means to negotiate a better insurance package upon its renewal.

b) **Construction Site Safety Trial** – APAS is conducting a trial project that aims to improve safety around large and heavy moving machineries in works sites controlled by Government department including Civil Engineering and Development Department, Water Supplies Department, Drainage Services Department, and Architectural Services Department. The project utilizes the R&D outcome of pedestrian warning & protection and image technology in the ADAS project to create a “red” zone around the heavy moving equipment. If the trial is successful, it is hopeful that number of serious accidents involving large and heavy moving machineries can be reduced.

c) **Trial of EV Charger** – APAS carried out two PSTS projects for the 20kW electric vehicle fast charging station in collaboration with the Electrical and Mechanical Services Department (EMSD) and Hong Kong Police Force to support the adoption of EVs. The trials not only captured valuable information of user experience and interface for future commercialisation but also led to the development of a faster (50kW) charging system that is more competitive and the first in the local and Mainland industry.

4. Promotion Activities and Liaison with Stakeholders, Including Local and International Collaboration

a) Promotional and Publicity

APAS organised and participated in more than thirty events and activities in promotion and industry activities per year since 2011-12. These activities consisted of a wide range of different industry stakeholders, Government department and agencies, universities and research institutions involving international, local and Mainland collaboration and events.

Annual APAS Showcase – In April 2015, APAS organised the first of its Annual APAS Showcase that attracted over 200 industry participants to the seminar and exhibition event. There were speakers from major carmakers as well as leading academics from Tsinghua University (清華大學) in the Mainland. Apart from business networking opportunities, a number of new project ideas and collaboration opportunities were generated for APAS to follow up.

b) Engaging the Local Industry and Government Departments

With a focus on EV technology, APAS worked with EMSD and property developers to enhance healthy development of charger infrastructure and requirement. APAS also actively liaises with Environment Protection Department (EPD), on matters related to the promotion of EV development in Hong Kong.

After the merger with HKPC, APAS was able to leverage its vast industry network for wider industry coverage of APAS activities. During the period, APAS conducted two industry network clusters (INC) to gauge industry demand & possible collaboration, and one technology consultation session to solicit stakeholders' view on the development and refinement of APAS' new technology roadmap.

A Study on EV Adoption in Hong Kong – In one of the INCs, the focus was on green mobility. The industry was found to be facing a number of issues that might significantly stifle the growth of the local EV industry and a wider adoption of EVs by Hong Kong citizens. As a result, APAS worked with HKPC to conduct a Study on EV adoption in Hong Kong in 2014. With views collected from local stakeholders and experience from overseas, the Study made a number of recommendations to encourage a wider adoption of EV both commercially and privately in Hong Kong.

c) Collaboration with Trade and Professional Associations

Over the years, APAS has developed valuable networking and relationship with trade associations, R&D institutions, professional organisations and industry partners in this arena. APAS developed a strategic partnership with Hong Kong Auto Parts Industry Association (HKAPIA) with over 130 companies to explore new business opportunity. APAS also signed a MOU with a large Mainland manufacturer to promote EV and

related technology in Hong Kong. The two parties also participated in an EV promotion program by the University of Hong Kong (HKU) to advocate concerns and opportunities in 2012-2013.

APAS also worked with Society of Automotive Engineers (SAE) Hong Kong and HKAPIA in the promotion of Hong Kong Automotive Parts and Components Industry in the Hong Kong Week in Xiamen in 2013. A number of Hong Kong industries participated in the event and found new potential partners in the Mainland as a result.

d) **Collaboration with Local and Overseas Universities**

APAS has maintained a good relationship with a number of universities in Hong Kong, the Mainland and overseas.

Local universities
APAS has initiated a number of projects in collaboration with City University of Hong Kong (CityU) in smart traffic applications and advance manufacturing techniques; and the Hong Kong Polytechnic University (PolyU) in topics related to EV charging technology and EV components. APAS also worked with the Chinese University of Hong Kong (CUHK) on hybrid technology while working on voice recognition with Hong Kong University of Science and Technology (HKUST).

Mainland
APAS worked with Tongji University (同濟大學) on technology related to the thermo-analysis of battery system. With Sun Yat-Sen University (中山大學), APAS developed EV battery power pack design and verification technology. In 2015, APAS opened a new discussion with Tsinghua University (清華大學) Department of Automotive Engineering for a broad range of collaboration in topics related to EV development. One potential project in discussion is in the development of a double-decker e-bus for Hong Kong.

International
Internationally, APAS actively searched for new technologies that could be applied to the local industry. For example, from a visit to Germany last year, a new project was initiated on manufacturing process improvement by applying laser technology. Once the project is completed, the innovative manufacturing technique would be acquired and mastered locally, hence enhancing and upgrading local industry.

APAS also visited Australia in 2014 identifying a number of potentially suitable new technologies in the areas of next generation EV batteries and carbon composite technologies. Separately, APAS is also working with Royal Melbourne Institute of Technology (RMIT) University in Australia to organise a series of technology seminars in 2015 on topics related to 3D printing, new materials and fuel cell technologies that will be of interest to the industry in Hong Kong. APAS aims to explore new project opportunities there.

5. SWOT Analysis

A Strength-Weakness-Opportunity-Threat (SWOT) Analysis of the development of APAS is set out below –

Strengths	Weaknesses
1. Excellent experiences in automotive R&D development methodology 2. Strong reputation in EV and charger technology development 3. Strong local industry network 4. Strong Government support 5. Skillful software & electronic engineering 6. Excellent project management experience & ethics	1. Insufficient number of staff 2. Relatively weak connection with OEM & tier 1 or 2 suppliers 3. Difficulty in recruiting of suitable automotive talents
Opportunities	**Threats**
1. Booming automotive and components markets particularly in EV 2. Rising demand of alternative fuel and green transportation 3. Increasing demand on safety, green and comfort features in overseas auto industry 4. Strong industry interests in various types of EV development 5. International and Mainland interests in collaboration	1. Few local 1st tier suppliers - lacks local investment in R&D 2. Mismatch in expectation from industry about technology R&D 3. Type approval process may cause delay in projects to meet market windows 4. Rapid changes and development of new technologies

PART 4 – FUTURE PLAN OF THE R&D CENTRE FROM 2017-18 TO 2020-21

1. Technology roadmap and R&D programme

A. An industry facing looming revolution

In the past five years, a revolution is looming in the global automotive industry. The industry is developing technology in different directions in order to comply with the stringent Government environmental regulations imposed upon them as a result of environmental concerns.

At the same time, the proliferation of smartphone and wireless technology to all walks of life has made "smart technology" a part of the common citizens demand from different products. Automotive is one of the last frontiers of the applications of smart technologies.

On top of the changing market demand, the rapid growth of auto industry in the Mainland provides a tremendous business opportunity for local automotive and component industry.

B. Market driven technology roadmap

To support the automotive parts industry, APAS has setup and constantly updated a market-driven technology roadmap to position its technology development direction for supporting the industry to upgrade and transform to producing high value products. Based on the technology roadmap, APAS uses both in-house capability and external partnerships to build a focus based on green sustainable technology. In a recent study of automotive sector and feedback from consultation with industry and academic partners, APAS observes three major trends in the industry –

a) **Growing demand for green vehicles** - As government policies in many countries, the promotion of clean energy vehicles has led to new business and technology opportunities in the development of EVs, hybrids and associated supporting facilities such as EV chargers.

b) **Increasing use of smart technology in auto application** - With advances in technology used in smart devices and telecommunications, there are increasing demands on applications of these technologies in infotainment, vehicle safety, navigation and driver assistance.

c) **Applying new material and process for automobiles** - New developments in material technology & process have resulted in strong potential of new light & strong materials in cars and manufacturing process.

Based on these new trends, APAS revised and refined its technology roadmap for the future in 2014. The centre has defined three technology focuses for future development: a) Green Transportation; b.) Smart Mobility and c.) New Materials and Manufacturing

Process. With its limited manpower resources, APAS will remain focussed on technology development in projects related to EV, with focus on commercial vehicles, and smart control area. It will rely on the collaboration with other R&D institutions on remaining areas of smart mobility and the new material and manufacturing processes.

In coming years, APAS will continue to focus on promoting and developing technology in the following thematic areas –

Technology Area	Thematic Contents
Green Mobility	Commercial Vehicle electrification / energy storage system / charging infrastructure / fuel saving & energy recovery
Smart Mobility	Intelligent control & analytics / smart module & infotainment / vehicle connectivity / Autonomous driving
Material & Process	Composite material / new manufacture process / ultra light & high strength material / advance coating

As a leading R&D institute in the automotive industry in Hong Kong, APAS will launch R&D programs to focus on market driven technology and strengthen competitiveness in the future –

a) In the energy storage area, APAS will look into fuel cell applications in EV, new development in the next generation battery technology such as Lithium-air, Lithium Sulphur and Aluminium battery.

b) In the smart mobility area, APAS will target thematic area in line with the smart city driven by the Government and improve driving experience with safety advisory.

C. Leveraging the strength of HKPC and other R&D Institutes

Since the merger with HKPC, APAS saw a very strong synergy with other divisions of HKPC. Not only can APAS now leverage the very wide business and industry network of HKPC, the wide range of expertise in areas of electronics, control, materials and manufacturing process provide a support to APAS by providing a comprehensive technical and R&D support to the industry in Hong Kong.

In addition, APAS also engaged local Universities and R&D institutions from Mainland, Japan, Germany, UK, Australia and United States. In order to tap into the vast expertise as well as market in the Mainland, APAS is planning to expand its collaborative multi-disciplinary research to Mainland universities such Tsinghua University (清華大學), Jilin University (吉林大學) as well as other universities / R&D institutes. APAS also intends to form a strategic partnership with these prestige automotive R&D institutions to leverage domain knowledge and create an impact to the Hong Kong automotive industry.

Going forward, making ready for the demands on sustainable green technology in the next few years, APAS will strategically develop the relevant expertise and IPs through seed and platform projects.

2. Commercialisation and Technology Transfer to the Industry

Commercialisation and technology transfer of APAS R&D results to the industry is the key objective of APAS in order to allow it to be relevant and beneficial to the Hong Kong industry. As a result, the Centre will adopt a three-pronged approach in driving results in commercialisation of APAS R&D portfolio –

a) **Emphasis on Collaborative Projects** – Collaborative projects have a higher potential to be commercialised because of industry partners' higher involvement in the projects and their higher level of financial commitment. These projects are also more commercially aligned with the market needs. As such, in order to see more R&D projects successful in commercialisation, APAS will put more emphasis on encouraging collaborative projects.

b) **Leveraging PSTS** – The PSTS is very successful as it allows not only sponsors to test trial the R&D outcome, but also the public to be aware and engaged with the advances in technology. APAS will continue to actively promote the project results.

c) **Strengthening of Contract Research** – Over the years, APAS has built up a significant profile of EV related technologies. In order to maximise the opportunities of these know-how, IPs and patents to be used by the industry, APAS plans to actively promote the development of contract research services.

3. Application of R&D Outcomes in the Public Sector and Benefits to the Community

a) Leveraging Public Sector Trial

As at March 2015, APAS conducted 8 projects under the PSTS. For these projects, APAS collaborated with Government departments, non-profit organisations, and community supporting groups. Apart from increasing the potential of commercialisation and building track record for completed projects, maximizing the benefits of R&D outcome to local communities is one of the major aims for APAS. In the coming years, APAS will continue to conduct more public sector trials as well as extend support for industry and Government.

b) Promoting EV Technology to the Community

A key research highlight of APAS is to promote green transportation that helps address the need in the region to improve the air quality and the environmental condition in which we live. APAS will continue to launch more trials in EV and charging

infrastructure development that will build the foundation and enable the proliferation of EV adoption. As EV related projects come to a fruitful stage, APAS expects to relay suitable technology to the community and encourage the adoption of green vehicles, hence to forge a positive impact on public health and increase the green image.

c) Supporting Hong Kong Smart City Initiative

APAS will identify new opportunities in its R&D focus that specifically target intelligent transportation and smart city design. Potential integrated trial projects with the Government and community will forge a closer partnership among the industry and community. The effort and purpose will not only provide practical solutions to solve practical issues that meet industry needs, but also will generate fundamental knowledge and benefit to the community.

4. Promotion Activities and Liaison with Stakeholders, Including Local and International Collaboration

The aim of APAS is to promote its technology know-how, R&D project results, as well as leverage the latest funding schemes to help local industries to go through business transformation. APAS aims to broaden its industry connection through campaigns such as commercialization seminars, open house, public exhibitions, road shows at local universities, as well as industry networking activities. The campaign will leverage HKPC's established marketing platforms, such as client networks, regular publications and direct marketing channels to enhance effectiveness and reach out to enterprises, universities and technology institutes, as well as automotive-related associations.

The major activities for APAS in coming years include –

a) **APAS Showcase** – APAS successfully carried out an "APAS Showcase" in April 2015 that will turn into an annual event with seminars and exhibition.

b) **Commercialisation and Technology Seminar** – APAS will continue the promotion of IPs from R&D projects for licensing opportunities on a regular basis. The seminar, with a smaller scale but more frequently organised, will introduce new development in technology in the automotive area.

c) **Open House** – As a part of the overall corporate image promotion, APAS will organise open house tour, possibly at the same time as the technology seminars.

d) **Roadshow at Local Universities** – APAS will organise roadshows on a quarterly basis to explore and seek collaboration opportunities with local universities.

e) **Exhibitions and Conference** – APAS aims to increase its international profile through participation in major international and regional exhibitions and conferences.

f) **Hong Kong Industry Network Clusters (INC) Event** – APAS will hold a yearly industry consultation session called INC with potential topics related to the latest

technology trends and the technology issues faced by the automotive industry at the time.

g) **E-Newsletter** – An e-newsletter is issued on a monthly basis that covers the latest technology development trends and emerging market development of the auto industry.

h) **APAS Website** – A website for APAS has been online, in English and Chinese, with a total of over 700 members in the R&D Club. APAS will continue to provide quality services to club members with the latest updates of R&D projects, commercialisation events, market trends, industry standards and other automotive-related Government policies.

i) **Leverage HKPC Network and Platform** –APAS will leverage the vast business network and various business platforms of HKPC, such as SME One and TecONE.

5. Budget and cashflow

The current approved commitment for the operation of APAS up to 31 March 2017 is $228.2 million. To support its continued operation up to 31 March 2021, an additional funding of $71.5 million is required for APAS, bringing the total funding commitment for 15 years of operation to $299.7 million.

Operating Expenditure (in $ million)

	5-year Cumulative 2006-07 to 2010-11	4-year Cumulative 2011-12 to 2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total
	(Actual)	(Actual)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	
Staff [(1)]	30.5	40.7	13.4	16.4	19.7	21.7	23.8	26.3	192.5
Accommodation [(2)]	7.6	6.4	2.2	2.4	2.7	3.1	3.6	4.1	32.1
Equipment and other capital cost[(3)]	18.6	3.1	1.3	1.3	1.5	1.5	1.5	1.5	30.3
Commercialisation[(4)] (including publicity, marketing, etc.)	2.7	2.0	0.6	0.8	1.0	1.1	1.2	1.3	10.7
Others[(5)]	11.8	9.0	2.2	2.2	2.4	2.5	2.7	2.9	35.7
Total expenditure:	71.2	61.2	19.7	23.1	27.3	29.9	32.8	36.1	301.3
Less: Admin. overheads[(6)]	0.8	0.8	-	-	-	-	-	-	1.6
Total operating cost from ITF :	**70.4**	**60.4**	**19.7**	**23.1**	**27.3**	**29.9**	**32.8**	**36.1**	**299.7**

Explanatory Notes –

(1) Staff cost covers basic salary, Mandatory Provident Fund contributions, medical insurance, merit increment, variable pay and salary and other staff benefit adjustment of 10% per annum. It is forecast that by 2017-18, the staff establishment of APAS will reach 37 centre staff. Depending on individual project needs, more staff funded by ITF projects will also be recruited. Staff cost has deducted income generated from centre staff involved in project work each year.

(2) The accommodation budget will benchmark with nearby buildings in Kowloon Tong such as InnoCentre, assuming an increase of 5% per annum. It is also planned that more office space is required to accommodate more staff due to the expansion of the size of APAS starting from 2017-18.

(3) APAS will continue to procure equipment for lab and R&D support purposes.

(4) There will be a gradual increase in commercialisation expenditure starting from 2016-17 for promoting R&D deliverables arising from more R&D projects are completed and enter into the commercialisation phase. The budget mainly covers expenditure for APAS showcases, exhibitions etc. as well as promotion and publicity of APAS.

(5) The “Others” item includes expenses on Utilities, Recruitment, Staff Development, Service Fee, Office Supplies, Printing & Stationery, Indemnity Insurance, Repair and Maintenance and Sundry, and Legal & Professional fees etc.

(6) It includes administrative overhead for in-house projects. Since merger with HKPC in November 2012, no administrative overhead has been incurred.

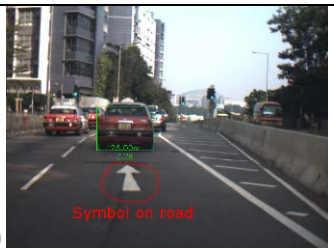
R&D Projects and Expenditure (in $ million)

	5-year Cumul 2006-07 to 2010-11 (Actual)	4-year Cumul 2011-12 to 2014-15 (Actual)	2015-16 (Estimate)	2016-17 (Estimate)	2017-18 (Estimate)	2018-19 (Estimate)	2019-20 (Estimate)	2020-21 (Estimate)	Total
No. of new projects commenced	47	34	17	20	23	25	30	32	228
No. of projects under commercialisation(1)	8	20	10	12	15	20	20	21	n/a
R&D expenditure ($ million)	89.9	92.6	51.0	70.0	80.5	87.5	105.0	112.0	688.5

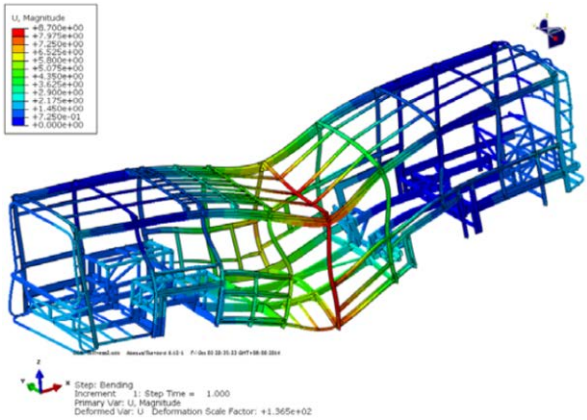
Explanatory Notes –

(1) Completed or on-going projects with technologies ready for commercialisation such as licensing and filing of patents.

PART 5 – PROGRESS OF SELECTED PROJECTS ON R&D, COMMERCIALISATION AND USE OF R&D OUTCOMES IN THE PUBLIC SECTOR IN 2014-15

Project / Technology	Status / Progress
New Generation Advanced Driver Assistance System (ADAS) (a)  (b)  *Challenges in the test video sequences.*	This ADAS project makes use of novel algorithms for the detection and tracking of moving objects by the shared use of motion vectors (MV) from H.264/AVC encoders. The proposed system splits the detection task into relatively fast moving objects detection and relatively slow moving object detection to address the problems of motion vectors from a typical H.264/AVC encoder. It reduces the cost and complexity of the system. The algorithm development has been completed and the porting of the algorithm to the selected embedded System-on-Chip is in progress. Thorough testing of the system will be conducted. The project is target to complete in August 2015.

Project / Technology	Status / Progress
Over-moulding Tandem Injection Moulding Machine   	This technology offers a one-stop high yield solution to produce a pair of interior panel with soft-touch leather-like feeling and appearance polyurethane top skin on a base plastic layer by one single process. This innovative process produces leather-like parts even with undercuts or sharp corners without wrinkles. It is superior to traditional labour intensive man-made method with adhesive. The tandem injection moulding process would double the productivity of the traditional process using a similar machine size. The project was successfully completed in August 2014. The first open house was organised in December 2014 to promote the developed technology to the industry. A seminar and a live demonstration of the machine production have been conducted. Over 200 participants including plastic product manufacturers, automotive components manufacturers, mould makers and others have attended the open house. Positive feedbacks and enquiries were received and the project collaborator has already kicked off the discussion with some potential clients.

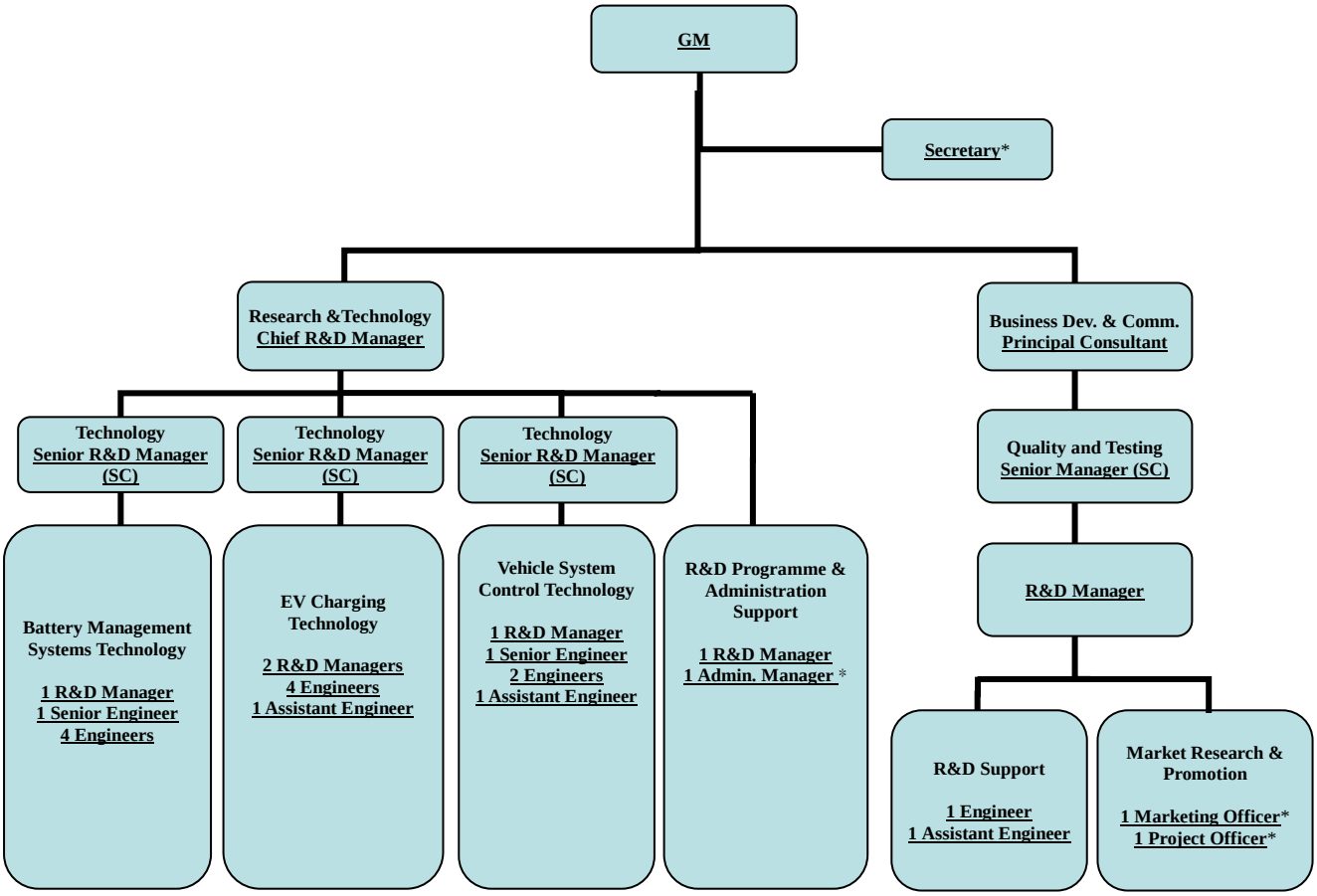
Project / Technology	Status / Progress
“Made by Hong Kong” eBus   	The project team aims at developing the first “Made by Hong Kong” electric bus. Two single-deck pure electric buses (eBus) are being designed for the Mainland and Hong Kong markets. The lightweight eBus body is made of high quality aluminium alloy (6082-T6 grade) and a comprehensive Finite Element Analysis (FEA) has been conducted to improve the design of monocoque body structure. The powertrain system of eBus adopts a compact and high efficiency Permanent Magnet Synchronous Motor (PMSM). The assembly of both e-buses (Left-Hand-Drive and Right-Hand-Drive) has been completed in April 2015. Meanwhile, functional verification and test has been completed successfully in the Mainland. Application to the Hong Kong Transport Department (TD) has been made for the movement permit for the RHD eBus. Once the movement permit will be in place by TD in August 2015, road tests in Hong Kong can begin from September to October 2015. Project sponsor has a holistic plan for the promotion and commercialisation of eBus after project completion at the end of 2015. Moreover, project team will apply for PSTS funding to make eBus prototypes available to supporting organisations.

Project / Technology	Status / Progress
EV Quick Charger  *CHAdeMO certificate obtained in June 2014*  *News reported*  *Trial at Tamar*	In 2012, APAS has successfully developed a 20kW EV Fast Charging Station. It has greatly reduced a sedan EV charging from 14 hours down to 1.5 hours. In 2014, APAS developed the 50kW charging station. In addition to further reduce the charging time down to less than 0.5 hour; APAS has also attained the CHAdeMO certification to this technology that is the most widely adopted international standard on EV charging worldwide. This is one of the kind in Hong Kong and the Mainland that passed this stringent standard certification. Currently APAS is working with industry sponsor to pursue several major commercialisation opportunities. <u>Public Sector Trials on 20kW Smart Fast Charging Station</u> APAS has installed a 20kW Fast Charging Station at the Central Government's Offices at Tamar to provide charging services for Government's vehicles. The system has reduced charging time significantly to about 1 hour. Within the three-month period, the system has used more than 90 times with 600kwh used.

Project / Technology	Status / Progress
Bus Infotainment System     	The project team has developed the First On-board Infotainment Product for Coaches in the World based on MOST150 Technology. <u>1st Generation MOST System</u> The project team has successfully developed the 1st gen MOST system through the R&D Platform project (ITP/001/09AP) from 2009 to 2011. The system was able to linkup 1 server and 60 monitors. Since 2012 the team has worked with the sponsor to commercialise the R&D results in Thailand. <u>Public Sector Trial Project</u> With the continuous funding support from ITC, the team has been conducting a Public Sector Trial Project (ITT/002/ 13AP) to facilitate the adoption of MOST system (Hong Kong's technology) in Hong Kong. Total 3 non-profit making organisations. The system obtained the type approvals by Transport Department (TD) to carry out the road tests. The Guangdong-Hong Kong cross-boundary bus company (GDHK) are very eager to deploy the MOST system in their fleet for enhancing the quality of services provided to the passengers. The system has been installed on 30 GDHK buses and will be installed on 200 buses in 2015. <u>2nd Generation MOST System</u> To further the capability of MOST technology, the team continued with the sponsor to develop the 2nd generation (Gen) MOST system through a collaborative project in 2014. The 2nd Gen system uses a scalable multi-ring technology. The teams target to promote the 2nd Gen system to double-deck buses and high-speed trains after project completion in Q2 of 2015.

Appendix

Organisation Chart of APAS



* 4 Non-R&D Staff
Total 33 posts under the approved establishment

Annex B

Comprehensive Review on R&D Centres 2015

Hong Kong Applied Science and Technology Research Institute (ASTRI)

PART 1	**Highlight of Operation in 2014-15**
PART 2	**General Background**
PART 3	**Evaluation of the Performance of the R&D Centre from 2011-12 to 2014-15**
PART 4	**Future Plan of the R&D Centre from 2017-18 to 2020-21**
PART 5	**Progress of Selected Projects on R&D, Commercialisation and Use of R&D Outcome in the Public Sector in 2014-15**

A video featuring selected achievements of ASTRI is available at the following link –

https://www.youtube.com/watch?v=HTJkOavzbeQ

PART 1 – HIGHLIGHT OF OPERATION IN 2014-15

I. New R&D Projects and Industry Contribution (in $million)

	2013-14			2014-15		
	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution
Platform	20	226.9	37.5 (16.6%)	19	241.3	47.4 (21.8%)
Collaborative	3	35.3	16.4 (46.4%)	3	31.4	16.2 (51.6%)
Seed	9	17.6	n/a	17	46.4	0.1 (0.3%)
Total:	32	279.8	53.9 (19.3%)	39	319.1	63.7 (21.6%)
Public Sector Trial Scheme	-	-	n/a	5	15.1	n/a

Note: *Figures in brackets denote the level of industry contribution.*

II. Operating Expenditure (in $million)

	2013-14	2014-15
Staffing	75.4	72.8
Accommodation	25.0	25.8
Equipment	3.6	2.1
Others	25.5	22.3
Total:	129.5	123.0

III. Industry Income Received (in $million)

	2013-14	2014-15
Sponsorship for projects	55.38	52.18
Licensing/Royalty	8.21	12.11
Contract Services	9.42	12.02
Others	14.50	0.61
Total:	87.51	76.92

PART 2 – GENERAL

1. Mission and vision

The vision of ASTRI is to be a world-class technology developer and enabler to enrich life.

The mission of ASTRI is to enhance Hong Kong's competitiveness through applied research.

2. Institutional set up

ASTRI was founded by the Government of the Hong Kong Special Administrative Region in 2000 with the aim of enhancing Hong Kong's competitiveness in technology-based industries through applied research.

In 2006, ASTRI was designated as the R&D Centre for Information and Communications Technologies.

In 2012, ASTRI received the approval from the Ministry of Science and Technology to establish, in collaboration with the Southeast University in Nanjing, the first Hong Kong Branch of National Engineering Research Centre, namely National Engineering Research Centre for Application Specific Integrated Circuit (ASIC) System (Hong Kong Branch).

3. Organisation

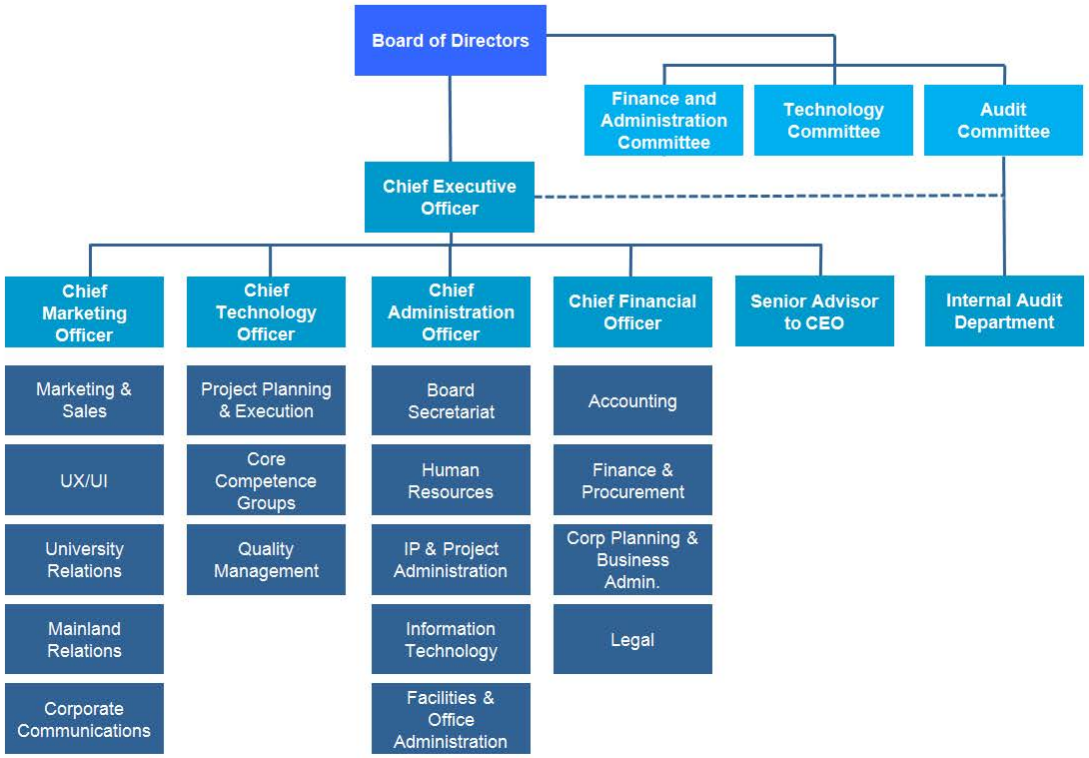
ASTRI is headed by a Chief Executive Officer and is governed by a Board of Directors comprising representatives from the industrial and commercial sectors, the academia and the HKSAR Government. Three functional committees, namely Finance and Administration Committee (FAC), Technology Committee (TC) and Audit Committee (AC), assist the Board in managing the business of ASTRI. FAC oversees ASTRI's finance and administration matters; TC oversees research initiatives; and AC ensures both internal and external audit processes are properly carried out.

ASTRI's core R&D competences in various areas are organised under seven Technology Divisions, namely Integrated Circuit (IC) Design (Analog), IC Design (Digital), Opto-electronics, Electronics Components, Software and Systems, Security and Data Sciences, and Communications Technologies. Four areas of applications including financial technologies, intelligent manufacturing, next generation networks, and medical and health are identified for major pursuit.

As at 31 March 2015, the staff strength of ASTRI is 512, against an establishment of 563 posts including the Chief Executive Officer. An organisation chart is shown as follows -

Hong Kong Applied Science and Technology Research Institute

Organization Chart



R&D Structure

Technology Divisions

IC Design (Analog) | IC Design (Digital) | Opto-electronics | Electronics Components | Software & Systems | Security & Data Sciences | Communications Technologies

Core Competence Groups

RFIC Design	Memory	Sensors	Packaging	Mobile Computing & System	Cyber Security	Baseband Solutions
Low Power Design	Video	Modules & Integration	Li Battery	Smart Living	Data Analytics	Networking Software
Design Technology	Communication	Manufacturing Technology		Embedded Systems	Cloud Computing	Emerging Systems
Optical Communication IC Design	ASIC Implementation			Multimedia Processing	Video Analytics	

Joint Labs, Consortiums, and Research Centres

National Engineering Research Centre for ASIC System (HK)

ASTRI-HP Information Technology Research Centre

ASTRI Security Lab

PART 3 – EVALUATION OF THE PERFORMANCE OF THE R&D CENTRE FROM 2011-12 TO 2014-15

1. R&D Achievements

Starting from 2013-14, ASTRI has aligned its industry contribution calculation method with that of other R&D Centres by reporting pledged sponsorship. Prior to 2013-14, ASTRI adopted a different method of calculating industry contribution by reporting received income. Improvement has been observed in pledged income of 21.6% in 2014-15 over 19.3% in 2013-14.

ASTRI has also seen expansion in terms of projects commenced. In 2014-15, the number of projects commenced by ASTRI was 44, which was increased from 32 in 2013-14 while the total number of project commenced was 261 between 2006 - 2013. ASTRI has maintained its momentum in conducting collaborative projects over the past two years in which 3 new collaborative projects were commenced in each of 2013-14 and 2014-15. As an example, ASTRI successfully conducted a collaborative project with Hewlett Packard (HP) of Hong Kong in 2013 for big data analytics development.

ASTRI has also launched 7 Public Sector Trial Scheme (PSTS) projects since 2012-13 in which five of them were commenced in 2014-15. Examples of trial partner organisations include Hong Kong Police Force and Hong Kong Housing Society.

Number of ITF Projects Commenced

No. of Projects Commenced:	2011-12	2012-13	2013-14	2014-15
Platform Projects	13	15	20	19
Seed Projects	10	20	9	17
Industry Collaborative Projects	4	1	3	3
Public Sector Trial Scheme Projects	0	2	0	5
Total	**27**	**38**	**32**	**44**

During the period from 2011-12 to 2014-15, ASTRI filed 316 patents in countries such as the US and China, bringing the total of patent filing to 842 since 2006. Among the 842 patent applications, 557 have been granted so far. Such a strong patent portfolio has enabled licensing and patent assignment businesses over the years. As an example, ASTRI and a consumer electronics company reached a long-term strategic partnership. In 2015, ASTRI has leveraged patents from other local institutions by forming a patent pool with Hong Kong Polytechnic University (PolyU), Hong Kong Baptist University (HKBU) and Hong Kong Productivity Council (HKPC). This patent pool has a total of over 700 granted patents in the information and communications technology (ICT) area.

Number of Patents Filed and Granted

	2011-12	2012-13	2013-14	2014-15	Total (Since 2006)
No. of Patents Filed	101	93	72	50	842
No. of Patents Granted	106	130	95	99	557

ASTRI received many awards during 2011-12 and 2014-15 based on its technology outcomes or achievements. They include a number of Hong Kong ICT Awards, e.g. Best Lifestyle (Social, Communications & Media) Grand Award 2012 and Best Mobile Apps (Mobile Information) Gold Award 2014.

2. Commercialisation and Technology Transfer to the Industry

ASTRI made steady efforts on commercialising R&D outcomes and has received a total of $293.3 million with a total of 364 technology transfers from 2011-12 to 2014-15 as follows -

	2011-12	2012-13	2013-14	2014-15
Total Number of Technology Transfers	83	113	88	80
- *Industry Collaborative Project agreements signed*	*4*	*1*	*3*	*2*
- *Contract research project agreements signed*	*51*	*75*	*60*	*46*
- *Licensing agreements signed*	*28*	*37* [Λ]	*24*	*32* [Λ]
- *Patent assignment*	*0*	*0*	*1*	*0*
Total Income Received[1] (in $million)	60.9	68.0	87.5	76.9

[Λ] *Some licensing agreements include contract research services provided by ASTRI.*
[1] *Including cash and in-kind contribution.*

3. Application of R&D Outcomes in the Public Sector and Benefits to the Community

During the period between 2011-12 and 2014-15, ASTRI launched a total of seven Public Sector Trial Scheme (PSTS) projects and two platform projects initiated by Government departments to promote the applications of R&D outcomes in the public sector and benefits to local community.

The supporting Government departments and NGOs include Hong Kong Police Force (HKPF), Office of the Government Chief Information Officer (OGCIO), the Office of the Communications Authority (OFCA), Tung Wah Group of Hospitals (TWGHs), Education Bureau (EDB), and Hong Kong Housing Society (HKHS) involving the following application areas –

(i) wireless communications (HKPF, OFCA and OGCIO);

(ii) e-learning at schools (EDB and HKPF); and

(iii) health/elderly care (HKHS and TWGHs).

ASTRI also works with other R&D centres, namely the Hong Kong Research Institute of Textiles and Apparel (HKRITA) and the Hong Kong R&D Centre for Logistics and Supply Chain Management Enabling Technologies (LSCM), to conduct corresponding trials in the field.

4. Promotion Activities and Liaison with Stakeholders, Including Local and International Collaboration

As a public-funded applied research institute, ASTRI operates under the public mission of bringing benefits to industries and the community. In the past years, ASTRI hosted Industry University Collaboration Forum (IUCF) in Hong Kong and Shenzhen every year to solicit interests from industries and universities for collaborations in its new projects. It also hosted Seminars, corporate visits and signing ceremonies on various kinds of collaborations to promote ASTRI and its developed R&D outcomes. Moreover, ASTRI actively participates in local and regional events such as Inno-carnival, ICT Expo, China Hi Tech Fair, Inno Design Tech Expo and interviews/meet-up with the media to promote its new innovations to the community and enhance public awareness. The following table shows the summary of promotional activities during 2011-12 to 2014-15 –

	2011-12	2012-13	2013-14	2014-15
No of visitors to ASTRI website	103,763	124,596	133,470	115,293
No of exhibitions/roadshows organised/ participated	16	18	35	23
No of conference/seminars/workshops organised/participated	90	78	82	87
No of other publicity activities organised, e.g. media, visits to ASTRI, corporate publications	182	263	273	298
No of e-newsletters	5	6	6	6
No of publicity videos produced and made available to public	7	22	11	22

ASTRI has established 3 consortia to liaise with industrial companies for customer/partner engagement. They are Advanced Packaging Technology Consortium, Digital Living Consortium and ASTRI Antenna Consortium. The total number of active members up to the end of March 2015 was 309.

In addition, ASTRI, in collaboration with Hong Kong Science & Technology Parks Corporation (HKSTPC) and Shenzhen Micro & Nano Institute established the Shenzhen HongKong Microelectronics Co-innovation Consortium in April 2015. This consortium aims to provide an open platform for Shenzhen and Hong Kong micro-electronics industries, universities and research institutes to promote collaborations

and share service resources. A CPU/MPU/GPU seminar was held on the launching date. There have been 18 members from Shenzhen and 7 members from Hong Kong, and more collaboration opportunities will be created through this platform.

ASTRI was very active in exploring partnership with companies and Government authorities in Hong Kong and the Mainland. Exhibitions/roadshows, conference/seminars/workshops and other publicities were conducted to promote ASTRI and the technologies developed. ASTRI also co-organised events with strategic partners to promote greater commercialisation in technologies.

5. SWOT Analysis

A Strength-Weakness-Opportunity-Threat (SWOT) Analysis of the development of ASTRI is set out below –

Strengths	**Weaknesses**
1. Highly qualified R&D staff (480+), over 70% with master degree or above 2. Diversified workforce in multiple technology disciplines 3. Strong patent Portfolio in ICT areas (500+ granted patents) 4. Good strategic relationship with top-tier companies, e.g. HP	1. Difficult to achieve sustainability and scalability 2. Insufficient in-depth marketing intelligence because of wide coverage of technology applications 3. Limited supply of science and technology talent pool locally
Opportunities	**Threats**
1. Mainland strategic directions on high tech development and other policies 2. Fast changing and cross discipline ICT market 3. Already existing strong industry, e.g. finance, manufacturing in the Pearl River Delta (PRD)	1. Strong competition from the regional R&D 2. Fast changing pace

PART 4 – FUTURE PLAN OF THE R&D CENTRE FROM 2017-18 TO 2020-21

1. Technology roadmap and R&D programme

With the launching of key initiatives such as the "Belt and Road Initiative" and the upcoming 13th Five-Year Plan, it is not difficult to foresee the world's economy will be shifting eastwards within the next 20 years[1]. China will be the world's biggest market everyone will compete, including those from Hong Kong. With the renewing thrusts on technology innovation by the country, and with the continuous creation and setting of China-custom standards, it is important for us at ASTRI to adhere with the national policy for years to come. It is arguably the biggest opportunity presented to the wide spectrum of Hong Kong technopreneurs and industrialists.

At the strategic level, ASTRI will align its R&D directions in ICT with that of the 13th Five-Year Plan, which will start from 2016 and last until 2020. In other words, ASTRI will align its strategic R&D directions with those set forth for the country by the best engineering and business people available in the country. It should be stressed that it is far more important for ASTRI to identify Hong Kong available core strength, leverage its existing infrastructure and ecosystem, and place its resources where ASTRI have the highest chance of success. This includes Hong Kong and its surrounding regions, such as the Pearl River Delta where Hong Kong industrialists have heavily invested.

ASTRI R&D Directions

The recent structural reorganisation allows ASTRI to take on broad initiatives, each of which requiring the wide spectrum of the core competences ASTRI has been developing. Its initiatives also have strong local references and aim to create bigger values and thus greater impacts to the society. Through these initiatives, ASTRI intends to address the long awaited scalability and sustainability issue. In the order of priorities, these initiatives are –

1. Financial Technologies (FinTech)

   Being the 3rd largest global and China's 1st largest financial centre, Hong Kong, similar to New York and London, has all the "ingredients" (smooth operation regulatory body, end customers, technology developers, service providers, and venture funds) as needed in the ecosystem to become a world's FinTech hub.

   ASTRI plans to focus on network security, big data analytics and mobile platform. There are other areas of interest, such as crypto-processor, application of IoT in mobile payment, and communication and device development, and ASTRI's guiding principles will be from the market. ASTRI has also launched the ASTRI Security Laboratory to share security information and to serve local institutes and the Government.

[1] Keynote speech, Mark A. Weinberger, Global Chairman and CEO, EY, 2015

2. Intelligent Manufacturing Initiative (IMI)

Intelligent manufacturing has been identified as one of the key national strategies. "Made-in-China 2025" is the strategy to upgrade the manufacturing industry in China from big to strong and aims at becoming one of the top 4 by 2035. Earlier this year, Guangdong Province announced a big thrust of investment on robotics and automation within coming years. At least 10% of the total manufacturing revenue in China was contributed from PRD in 2014 where many Hong Kong industrialists have invested heavily over the years.

Intelligent manufacturing system has become a trend, it combines innovative manufacturing process with network services and transforms the present labour intensive operation to information centric operation. In the future, the mass production industry may encounter fundamental changes, for example, from production of large quantity of a few products into collaborative design and production of a small amount of diversified products to meet the rapidly changing market demands. Under the global trends, via robotic, integrated power module packaging, big data analytics, communications and virtual prototyping, it will improve manufacturing / plant effectiveness and productivity and address future workforce reduction challenges. These are also the focuses of our intelligent manufacturing R&D works in coming years.

ASTRI will focus on robotic vision (application vary widely for example defect inspection) and big data analytics (e.g. predictive analysis) over the next few years. It will also work on virtual prototyping and 3D packaging for integrated power module.

3. Next Generation Network (NGN)

Hong Kong is among the best cities in the world for its communications infrastructure. This includes the rapid deployment of the 3G and 4G wireless and fiber-to-the-building wireline communication networks. In terms of talents, Hong Kong has top-level universities and wireless experts in ASTRI.

ASTRI has been actively participating on national 5G and IoT standardization efforts. Furthermore, ASTRI is migrating its development efforts from 4G to 5G and focusing on 5G small cell and networking technology development, IoT technology development, and establishment of a NGN Testbed in Hong Kong for trials and industry engagement. An application platform supporting various next generation applications (e.g. FinTech, IMI etc.) is also ASTRI's focus to put Hong Kong on the global map on technology deployment.

4. Medical and Health Initiative (MHI)

Hong Kong will have 26% population aged 65 and above by mid-2031,

according to the Census and Statistics Department. With the changing demographics in Hong Kong and the urgent need of home care replacing those from the hospitals to reduce cost, ASTRI has been and will continuously be working with other research organisations on various technology development and deployment. Medical Imaging, Medical (e.g. endoscope and laryngoscope) and Health electronics devices (e.g. non-invasive pulse oximeter and blood glucose measurement) and coupled with big data analytics is one of the areas ASTRI will focus on. Others may include communication, positioning and tracking, etc. ASTRI also supports the Government and NGOs on programs such as elderly care and community nurses.

Chinese National Engineering Research Centre (CNERC)

ASTRI hosts a branch of the CNERC dedicated for IC design, the first being established out of the Mainland. Over the next several years, ASTRI intends to develop several mega IC projects that may draw interest at the national level.

The first project will be the LTE based machine-to-machine (M2M) communication IC targeted for Internet of Things (IoT) applications / markets. The core IP developed will form the basis of all M2M communication and can be deployed on smartphones and other terminal devices (FinTech application), production floor (IMI), communication (NGN), and mobile health electronics (MHI).

Another mega IC project under exploration is about the development of an extendable multicore CPU which is high performance, low power and extendable. The target applications of the multicore CPU include smart phone, IoT SoC, high performance server, cloud computing and so on.

2. Commercialisation and Technology Transfer to the Industry

To position ASTRI to create the biggest impact to the industry in commercialisation and technology transfer, it will take up a new set of strategies as detailed below -

1. In order to produce more significant industrial and social impacts, ASTRI will pursue collaborations with larger scale enterprises while keep on serving SMEs. With the introduction of the Intelligent Manufacturing Initiative and the Financial Technology Initiative, it has a much bigger potential customer base including financial companies such as banks, and bring more opportunities to work with larger scale companies.

2. For the sake of continuity, long-term partnerships with strategic players will be encouraged and prompted. An example was that the transfer of compact camera module related technology to an electronics company headquartered in Hong Kong Science Park was also combined with an extended sponsorship support of 3 years.

3. ASTRI has identified and reorganised itself with many core competence groups (CCG), ranging from IC design, opto-electronics, packaging, embedded and cloud

based software, to communications technologies and systems. Each of the CCG will take up more than single projects from the 4 initiatives in their respective areas to consolidate resources while addressing the issues of scalability and sustainability.

4. ASTRI will strengthen talent training and structured collaboration through various platforms (e.g. ASL, Hong Kong Branch of CNERC, ASTRI Innovation Runway), joint R&D labs (e.g. ASTRI-HP Information Technology Research Centre), consortia (e.g. Shenzhen-Hong Kong Microelectronics Consortium), etc. with academics (universities worldwide) and R&D organisations. ASTRI will continue to organise various talks, seminars, conferences, and symposiums, and adopt flexible policy for academics to participate in ASTRI's research programs.

5. As a neutral organisation, ASTRI will offer services to important industrial sector in areas such as consulting and information sharing. An example is the launching of ASL in May 2015.

Moving forward, ASTRI will continue to step up its efforts in transferring R&D outcomes to the industry to enhance their competitiveness.

3. Application of R&D Outcomes in the Public Sector and Benefits to the Community

As one of its charters is to enrich life by promoting its applied research results to public sector and community, ASTRI has been and always will be open to this initiative, either by its own efforts or through various collaboration platforms with universities and schools, R&D centres, Government bureaux/departments, NGOs, etc.

ASTRI's strategies are as follows –

1. ASTRI will focus on contributing where it has the core technical competences and deployable R&D results. ASTRI may not have all the necessary domain expertise to ensure the deliverables. Its counterparts from the Government and NGO will fill this gap.

2. ASTRI should have clear business models and identified clear business partners at preparation. With the technology readily to be deployed, there should be at least one business partner ready to support the typical 7x24 types of services upon the project completion.

3. ASTRI wish to see technology deployment in the end. Technology deployed in the community should be robust, reliable, user friendly, and with performances meeting all the requirements and standards. It should be stressed that industrial designs and user friendliness will be highly considered and should be integrated as part of the deployment plan. As appropriate, ASTRI will collaborate with the Government, NGOs or other relevant parties.

4. Clear deliverables and goals have to be defined on the trials for public sectors and community. These valuable public field trials will provide the much-needed information on the product reliability, quality, user feedback on improvements, and its confidence level on this technology. Various "design experiments" will be integrated in the program to obtain such information.

For the next 10 years, Hong Kong will adopt many new applications requiring far more new technologies for the public sectors and community that will leverage the core competences of ASTRI and many R&D organisations. These will include Internet of Things (sensors plus data analytics), Long Term Evolution (LTE)/4G and 5G networks, customized IC designs, security and data sciences, mobile platform technologies, etc. which are covered by the core competence groups in ASTRI.

ASTRI has identified the following Government departments and NGOs as partners for the application of R&D outcomes in the public sector in respective areas –

1. Financial Services: Hong Kong Monetary Authority (HKMA), HKPF and others. Local banks, financial institutes and small and medium-sized enterprises (SMEs) in private sector may also join the activities and enjoy the benefits.

2. Public Safety and Recreation: HKPF, Immigration Department (IMD), OFCA, OGCIO, Leisure and Cultural Services Department (LCSD) and others.

3. Medical and Health: Hospital Authority (HA), HKHS, TWGHs, LSCM, HKRITA and others

4. Education: Education Bureau (EDB), HKPF and others.

4. Promotion Activities and Liaison with Stakeholders, Including Local and International Collaboration

There are various stakeholders including Government departments, universities, R&D organisations, and enterprises at the local, regional, national and at international levels. ASTRI's priority will be set highest at the local, then regional, national and international levels. It will place emphasis on aligning with national strategic level on collaboration and directions for the benefits of future development of Hong Kong.

Common to all the levels, ASTRI will continue promoting the organisation and directions, collaborations, R&D results, achievements and awards, marketing and technical information through conferences, seminars, workshops, publicities and visits, media activities (press conferences, interviews, press briefings, advertorials, feature articles), consortia, etc. Websites, social media, mobile apps, advertisements, e-newsletters and publicity videos will be also leveraged and applied.

5. Budget and cashflow

Total expenditures incurred by ASTRI since 1 April 2006 up to 31 March 2015 was about $3,176 million which included R&D expenditure amounting to $2,144 million and operating expenditure amounting to $1,032 million.

Taking into account of the historical performance and other factors (e.g. the recent re-organisation for improving research capabilities and operation efficiency), it is assumed that the R&D expenditure would grow at 10% year-on-year, and the proportion of operating expenditure to total funding would be decreased from 36% in 2015-16 to 29% in 2020-2021.

Operating Expenditure (in $ million)

	5-year Cumulative 2006-07 to 2010-11 (Actual)	4-year Cumulative 2011-12 to 2014-15 (Actual)	2015-16 [6] (Estimate)	2016-17 (Estimate)	2017-18 (Estimate)	2018-19 (Estimate)	2019-20 (Estimate)	2020-21 (Estimate)	Total
Staff [1]	310.8	294.7	85.0	83.6	87.8	92.2	96.8	101.5	1,152.4
Accommodation[2]	74.0	96.5	27.3	29.6	31.1	32.7	34.3	36.0	361.5
Equipment and other capital cost[3]	27.1	14.8	2.1	2.5	2.7	2.8	2.9	3.1	58.0
Commercialisation[4] (including publicity, marketing, etc.)	10.4	12.6	4.1	3.3	3.5	3.7	3.9	4.0	45.5
Others[5]	104.0	86.8	29.1	22.2	23.3	24.5	25.7	26.9	342.5
Total expenditure:	**526.3**	**505.4**	**147.6**	**141.2**	**148.4**	**155.9**	**163.6**	**171.5**	**1,959.9**

Explanatory Notes –

(1) Staff cost includes basic salaries, Operational Reserve (for R&D staff), Mandatory Provident Fund contributions, variable payment, medical and life insurance.

(2) Accommodation includes rent, rates and management fees.

(3) Equipment includes IT equipments, furniture and fixtures.

(4) Commercialisation includes advertising, PR activities, commercialisation and marketing activities, tech forum expenses.

(5) Other costs include IP management, consultancy, legal & professional fees, utilities expenses, general office expenses, etc.

(6) Operating expenditure for 2015-16 is according to the revised budget as approved by the Board in December 2014.

R&D Projects and Expenditure (in $ million)

	5-year Cumulative 2006-07 to 2010-11 (Actual)	4-year Cumulative 2011-12 to 2014-15 (Actual)	2015-16 (Estimate)	2016-17 (Estimate)	2017-18 (Estimate)	2018-19 (Estimate)	2019-20 (Estimate)	2020-21 (Estimate)	Total
No. of new projects commenced	196	141	47	50	53	56	59	62	664
No. of projects under commercialisation (1)	170	64	16	18	20	22	25	28	n/a
R&D expenditure (2) ($ million)	1,114.0	1,030.4	260.6	286.6	315.3	346.8	381.5	419.7	4,154.9

Explanatory Notes –

(1) Completed or on-going projects with technologies ready for commercialisation such as licensing and filing of patents.

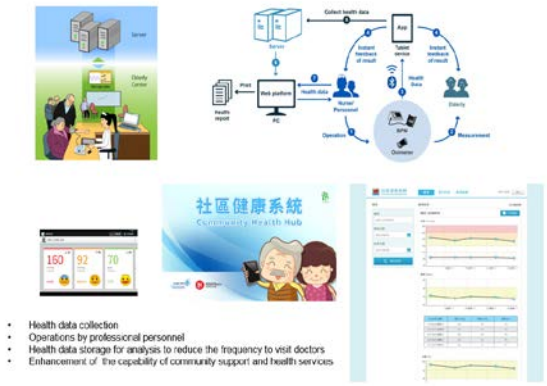
(2) Assuming annual growth rate of 10% for R&D Expenditure from 2015-16 to 2020-21.

PART 5 – PROGRESS OF SELECTED PROJECTS ON R&D, COMMERCIALISATION AND USE OF R&D OUTCOMES IN THE PUBLIC SECTOR IN 2014-15

Project / Technology	Status / Progress
ASTRI-HP Information Technology Research Centre  *Managing Director of HP (HK), and Board Chairman and CEO of ASTRI*	ASTRI has commenced a collaborative project 'Bamboo: A Big Data Analytics Platform' with HP Hong Kong in November 2013. The project aims to provide an easy-to-use Big Data Analytics platform for enterprises. The platform is designed to empower both the technical users and non-technical users to improve their business decisions and operations by harnessing the value of Big Data. They can easily migrate the business intelligence data to the said platform and set up the data analytics workflow for their specific business domain via a user-friendly interface. The beta version of the platform has attracted quite a lot of customers' interests worldwide. ASTRI is are working with HP business units for the customer engagement of the trial on the platform.

Project / Technology	Status / Progress
Intelligent Wearable Information Display  *See Through Automotive Head-up Display (HUD)*	A head-up display (HUD) shows information exactly where you need it – directly in the line of the driver's sight. Drivers get all the important information without looking down to the instrument cluster. It is therefore a key technology for increasing both safety and comfort in the vehicle. A licensing agreement with was signed in September 2014 with Truly Semiconductor Co. Ltd. to licensing the see through automotive HUD technology. Truly Semiconductor is one of biggest manufacturing companies in China of small size LCD panel, touch panel and camera modules. To further the technology collaboration, Truly would have an ICP with ASTRI to work on HUD system and component optimization.

Project / Technology	Status / Progress
Self-organising and Coordinated LTE Small Cells  *Sunnada LTE small cell installed in the shopping mall for field trial*  *Sunnada LTE small cell demonstrated at MWC 2015*	The LTE small cell product developed by Sunnada, ASTRI's customer, is deployed for field trial on China Mobile's 4G LTE networks in Fuzhou, Shanghai and Beijing. The product was built based on the LTE baseband and reference design technologies developed by ASTRI. Collaborated with key industry leaders including Fujian Sunnada Communication and others, below latest technology were developed and showcased at the Mobile World Congress (MWC) 2015, held in Barcelona, Spain in March 2015. 1. LTE-Advanced small cell: Carrier Aggregation (CA) combining MIMO technology to provide even higher peak data rate; and 2. LTE small cell coverage extension with Distributed Antenna System (DAS): extended signal coverage extension on isolated spots in both indoor and outdoor environments.

Project / Technology	Status / Progress
Community Elderly Healthcare for Age-Friendly City  *Community Elderly Healthcare System*  *Demo to WHO's delegates*	This is a project under the PSTS. Technologies developed from ASTRI's Telehealth Technology Platform project are adapted for this community elderly healthcare system. Contributing to the area of Community Support and Health Services, one of the eight topic areas of Age-Friendly City, ASTRI customises its telehealth platform for trial in a senior citizen community under Hong Kong Housing Society (HKHS). The key health-related features supported by the system include health data collection, instant feedback on the collected vital sign measurement data, health data report generation, etc. The system was showcased to World Health Organisation's delegates during their visit to HKHS on 30 October 2014.

Project / Technology	Status / Progress
e-learning Trial for Police College  *Training for Disaster Victim Identification Unit*  *Training for Recruit Training Division*	ASTRI's e-Learning solutions has been customized for training purposes in the Training Collage of HKPF. ASTRI's solution is able to meet the very rigorous requirements on the confidentiality of the training materials and the security of the training devices set by the Force. In helping HKPF take advantage of e-Learning technologies in training, ASTRI's solutions have received considerable publicities. They were mentioned in Offbeat, the newspaper of the HKPF, as well as in Police Magazine (警訊), the long lasting TV program produced by RTHK. Furthermore, ASTRI has been invited to present the technology used in disaster victim identification in the upcoming Standing Committee Meeting of InterPol, to the law enforcement units of many other countries.

Annex C

Comprehensive Review on R&D Centres 2015

Hong Kong Research Institute of Textiles and Apparel (HKRITA)

A video featuring selected achievements of HKRITA is available at the following link –

https://www.youtube.com/watch?v=-_H1uPmNw3A

PART 1 – HIGHLIGHT OF OPERATION IN 2014-15

I. New R&D Projects and Industry Contribution (in $million)

	2013-14			2014-15		
	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution
Platform	10	39.0	6.8 (17.6%)	5	16.3	3.1 (19.5%)
Collaborative	11	41.9	21.5 (51.3%)	5	11.8	6.0 (51.0%)
Seed	-	-	n/a	2	4.2	0.1 (1.4%)
Total:	21	80.9	28.3 (35.0%)	12	32.3	9.2 (28.6%)
Public Sector Trial Scheme	4	3.3	n/a	13	11.4	n/a

Note: Figures in brackets denote the level of industry contribution.

II. Operating Expenditure (in $million)

	2013-14	2014-15
Staffing	13.5	15.6
Accommodation	1.9	2.4
Equipment	0.2	0.1
Others	5.5	6.0
Total:	21.1	24.1

III. Industry Income Received (in $million)

	2013-14	2014-15
Sponsorship for projects	18.23	1.29#
Licensing/Royalty	0.51	0.32
Contract Services	-	-
Others	1.01*	0.13*
Total:	19.75	1.74

* *Income from sales of prototype, membership income and sponsorship for conference/seminar*

\# *Excluding sponsorship directly collected by local research institutions from sponsors.*

PART 2 – GENERAL BACKGROUND

1. Mission and vision

The mission of HKRITA is to be the leading centre of excellence in research, development and technology transfer in textile, apparel, and footwear technologies. The major technology focus areas of HKRITA include –

(a) new materials and textiles and apparel products;
(b) advanced textiles and clothing production technologies;
(c) innovative design and evaluation technologies; and
(d) Enhanced industrial systems and infrastructure.

2. Institutional set up

HKRITA is a non-profit company wholly-owned by the hosting organisation, The Hong Kong Polytechnic University (PolyU).

The Board of Directors of HKRITA oversees the operation and development of the R&D Centre.

HKRITA is required to prepare annual plans and quarterly/annual reports on its operation and submit them to the Commissioner for Innovation and Technology for approval.

3. Organisation

As at 31 March 2015, the staff strength of HKRITA is 32. An organisation chart is at Appendix.

PART 3 – EVALUATION OF THE PERFORMANCE OF THE R&D CENTRE FROM 2011-12 TO 2014-15

1. R&D Achievements

HKRITA is working closer and closer with our industry. This is evident in the growing number of project collaborations and technology licenses that it has executed with its industry partners. Year on year HKRITA continues to experience more and more growth and closer working relationships.

HKRITA is also contributing more research outputs to our community. It currently has research projects and wear trials with two branches of disciplined services, three elderly care facilities, and several athletic teams as they prepare to represent Hong Kong in next year's Olympic Games.

Overall HKRITA's research projects and outputs continue to contribute to tackling our industry and society's key challenges with competitiveness, sustainability and technology upgrade.

For the last 4 fiscal years HKRITA's industrial contribution level stood at a healthy average of **30.3%** and has added **83** new projects.

Working with its industry partners, HKRITA identified several research gaps to critical domains. Building on the support of the industry, HKRITA has taken on in-house research projects in the 2 areas of "High Performance Materials" and "Environmentally Friendly Technologies". These research efforts not only fill known gaps, but at the same time fostering a more open "platform" approach to cross discipline research challenges.

2. Commercialisation and Technology Transfer to the Industry

HKRITA Business Development team has been established since September 2010 to promote and commercialise its R&D project deliverables to the industry. The team has conducted different business activities to introduce project technologies to the industries and foster commercialisation of technologies, through different promotion and networking channels.

HKRITA signed **31** licensing agreements from 2006-07 to 2014-15 and the total commercialisation income received for the nine years is HK$8.6M.

Successful examples of commercialisation /technology transfer –

(a) Finer Nu-Torque Cotton Yarn Production

"Nu-torque" continues to be HKRITA's most productive technology; non-exclusive licenses have been issued to six (6) companies which generating over HK$8M. Now in its 5th generation of development, it anticipates this to slow

down as newer technologies take its place.

(b) Advanced Clothing Functional Design CAD Technologies

5 non-exclusive licenses have been issued to Guangdong Textile Polytechnic in the Mainland, a large fashion retailer in Canada, Shinshu University of Japan, Asahi Kasei Fibers Corporation also from Japan and Taiwan Textile Research Institute in Taiwan. Discussions with other interested companies are in process.

(c) Fabric Touch Tester (FTT)

HKRITA began commercialisation of its hand touch FTT technologies in 2013. Market response has been very positive, 6 units of the system were sold through its licensee and it expects to see more sales this year as the system has been put to commercial use. Besides, HKRITA has been working on an international testing standard organisation to make the technology a benchmark and global standard for the industry.

3. Application of R&D Outcomes in the Public Sector and Benefits to the Community

HKRITA has been working with multiple public organisations to get the most out of its research outcomes to benefit our society and community.

The work of HKRITA benefits many walks of life. It worked with our athletics from the Hong Kong Sports Institute (HKSI) preparing for the 2014 Asian Games in Incheon Korea. In particular, it worked with the Hong Kong Rowing Team. For a year HKRITA prototyped and tested various designs and materials with them in preparation for their competition. At the Asian Games, our rowing team accomplished their best results were one of the best performing Hong Kong teams. They won their first ever Gold medal and 4 Silver medals. Their talent, hard work and commitment, supplemented with advanced gear paid off.

HKRITA also partnered with various Government departments like the Hong Kong Fire Services Department and the Marine Division of Hong Kong Police Force (HKPF) to work on their duty uniforms and extreme condition gear. These include heat management uniforms, and cooling and moisture management apparel systems.

HKRITA also engaged with non-profit service groups like the Tung Wah Group of Hospitals, the HK Jockey Club, and St James' Settlement to develop suitable textile based solutions for their work with the elderly, the sick, and the handicapped. These include Radio Frequency Identification (RFID) embedded tracking vests, impact resistant materials, and self-cleaning easy care fabrics.

4. Promotion Activities and Liaison with Stakeholders, Including Local and International Collaboration

HKRITA carried out a great variety of activities to promote its work and services to its stakeholders and to the public.

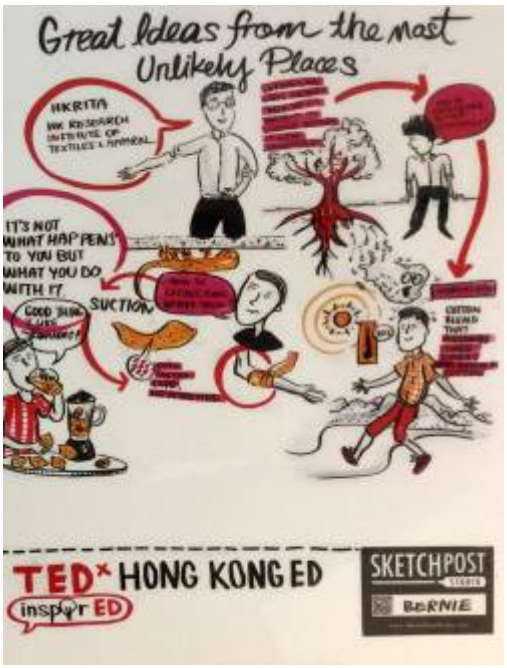
HKRITA organised regular conferences and technology seminars to talk about its work, get input from industry, and to forge closer ties with its stakeholders and research partners. Its biennial Innovation and Technology Symposium have been well-received by industry leaders and other research institutes in the textiles-related disciplines. In 2011, the symposium took place in the Hong Kong Science Park, providing a broader platform for technological exchange. In September 2013, HKRITA successfully organised its 4th symposium at an international textile trade fair at the Hong Kong Convention and Exhibition Centre. As well as our local industry, the event had speakers and participation from international brands and retailers. The event attracted over 300 local and overseas attendees.

To keep abreast of the industry developments, HKRITA has been taking part in multiple international events. Over the past few years, it participated and supported over 200 local and international exhibitions, seminars and workshops to promote its research deliverables, research capabilities and services to the textiles and clothing industry.

HKRITA has had a presence in Hong Kong Fashion Week since 2006. It has supported Business of IP Asia Forum (BIP) Asia Forum since 2011. It debuted in ITMA in 2011. This is one of the world's most established textile and garment machinery technology exhibitions. At ShanghaiTex 2013 HKRITA showcased its Fabric Touch Tester. ShanghaiTex is one of the world's largest machinery shows.

For HKRITA, international exchange and collaborations have in the past lead to technological advances. It maintains close contacts with top universities in material science, textiles, engineering, various technologies, and design. HKRITA has shared its research and technology with various global universities. These include Cornell University's Institute of Fashion and Fibre Innovation (fall 2014), North Carolina State University (fall 2014), Kansas State University's School of Engineering (fall 2014), University of Oregon's Sports Management Institute (spring 2015), and Tel Aviv University (spring 2015).

HKRITA has signed memorandums of understanding with key research institutions including Shinshu University of Japan, Deakin University of Australia, Australian Wool Innovation Limited, Cotton Incorporated of USA, China Textile Academy, and Donghua University.



HKRITA has reached out to the innovative sector through introduction of our work in events like TEDx (spring 2014), Prime Source Forum (spring 2015) and Textile Bioengineering and Informatics Symposium (fall 2014).

HKRITA has received about 40 local and international delegations from 2011 to 2015.

It has also developed different channels to gather ideas and comments on our technology and projects. These include online enquiry platforms on HKRITA's website, TDC online market place, and the Asia IP Exchange.

The communication efforts of HKRITA are not only to industry, but also to its broad stakeholders. InnoCarnival for example is one of the platforms HKRITA uses to engage the public and youth in Hong Kong. HKRITA has made use of InnoCarnival to highlight its projects and technology applications every year. Since 2012 HKRITA has also established its social media presence through Facebook, YouTube and LinkedIn.

Over the last few years, the efforts of HKRITA have not gone unnoticed in international innovation and technology competitions. So far, it has won **26** various international and local awards. **19** of these were received in the last 4 years.

One of the most significant international invention events globally is the International Exhibition of Inventions of Geneva. Over the years HKRITA has won 16 medals, including 7 Gold medals from this event.

At the 43rd International Exhibition of Inventions of Geneva that took place in April 2015, HKRITA won two gold medals and three silver medals.

Local awards that HKRITA has won over the years include the Hong Kong Award for Industries and the Hong Kong RFID Award.

HKRITA's recent accomplishments and awards have had growing media coverage. During the last 4 years it has been featured in over 200 publications.

PART 4 – FUTURE PLAN OF THE R&D CENTRE FROM 2017-18 TO 2020-21

1. Technology roadmap and R&D programme

"Delivering on the Promise" -- from HKRITA's beginnings to 2014
"The Race is On" -- From 2015 to 2021 and beyond

Delivering on the Promise – from HKRITA's beginnings to 2014

Historically, the textile and apparel industry of Hong Kong is a foundational industry. Today we have spread our ownership, influence, and dominance of this industry across the region and into all parts of the world. In past decades Hong Kong was an early adopter of the outsourced manufacturing model, today we are also supply chain managers, retailers, and brand owners.

HKRITA has contributed to this shift in our industrial involvement by engaging in research that supports and enhances our new business needs and market conditions.

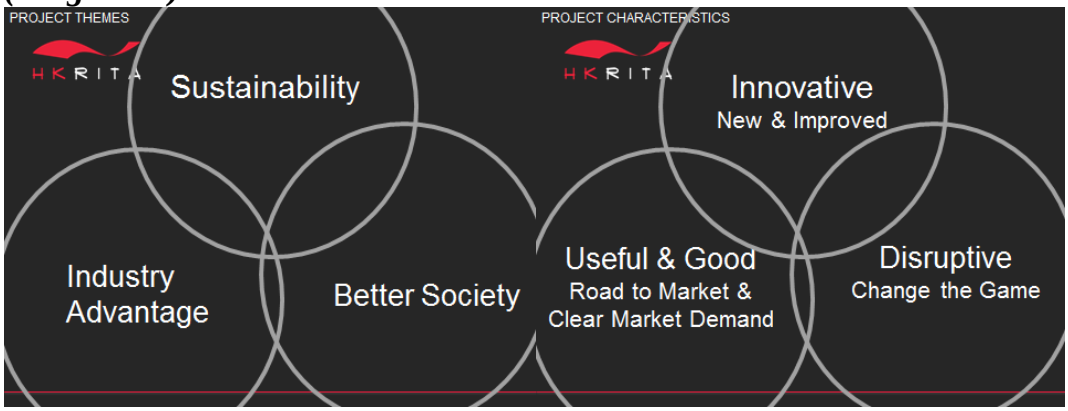
For the last few years, HKRITA has developed its technology themes with guidance and input from the industry. The result is the strong support from industry, deep commitment from its industry board, and ongoing research and licensing agreements.

Building on the success of its research framework in the fall of 2014 HKRITA undertook an exercise to add detail and focus to the work it is and wants to engage in. It also wants to develop a tool to clearly articulate its mission, purpose, and direction.

The result of this is HKRITA's "Call for Research". This laid out for HKRITA the rationale, methodology, and the desired impact it wants to deliver.

From the two dimensional more structured view of itself, HKRITA came to see the work in terms of major themes, overlapping clusters of projects, complementary cross disciplines, and desired outcomes (Diagram 1).

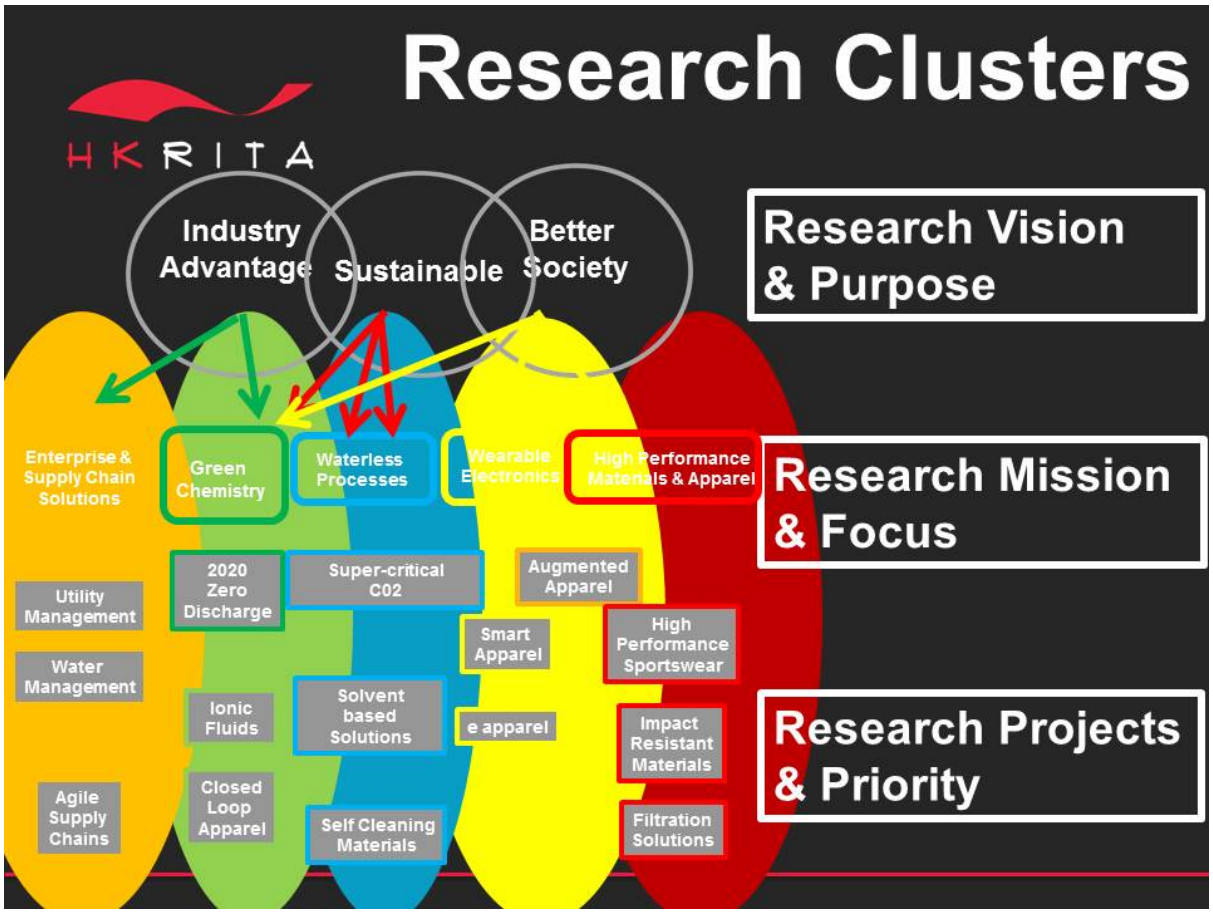
(Diagram 1)



By leveraging its learning, building on its existing IPs, and using knowhow from groups of related projects, HKRITA expects to be able to make even more significant impact.

By creating an open platform for research collaboration, HKRITA is making contributions in a rapid and cost effective manner. By grouping its projects into "clusters" it broadens its expertise, deepens its understanding, and grows its outcome applications (Diagram 2).

(Diagram 2)



HKRITA continues to build on its technology focus areas (new materials, production and evaluation technologies, and enterprise systems), and it stays true to its research themes around sustainability, industry advantage, and improvements for society.

Centre Owned Projects

For the last 18 months a new feature of HKRITA is the growing number of internal or centre-owned projects. Since inception HKRITA has leveraged external resources and partnered with other local researchers and institutions to conduct its research projects. As HKRITA matures in its research clusters, it found gaps in research activities, and issues with continuity due to the temporary nature of academic research teams. In response HKRITA has identified 2 domains in which it has built up cutting edge internal competencies to drive new and exciting projects. These are in the areas

of “Environmentally Friendly Technologies” and “High Performance Materials”. “Environmentally Friendly Technologies” deals primarily with the chemistry and engineering challenges of eliminating or reducing the use of water and energy in the manufacturing and care process of apparel and textile. “High Performance Materials” addresses the need for new material, systems, and apparel to address the need for athletics, elderly, various industries, and hospital patients.

HKRITA’s early results have been encouraging. Its first centre research on “solvent assisted dyeing” has got the attention of an international brand which is in discussion with HKRITA to develop a new project to create an industrial scale solution. HKRITA has inquires on its sleep comfort assessment project even though the project is still in very early stages. Its performance footwear project for our Olympic fencing team has met with great enthusiasm from both athletics and their coaches.

The 2020 High Performance Cluster

An important project cluster for HKRITA is the “2020 High Performance” family of projects. It wants to use the Japan 2020 Olympics as the theme for it to engage in a series of research around the assessment of apparel system performance, in the engineering of high performance apparel and footwear for competition, the development of new high performance materials, and new materials and systems that deliver performance in a sustainable manner.

2020 is also the industry’s general deadline to detox its production supply chain, eliminate the use of various classifications of hazardous chemicals, and address issues around environmental sustainability, and social compliance. This is part of the 2020 “Zero Discharge of Hazardous Chemicals (ZDHC) industry commitment. HKRITA is engaged in a series of projects, and designing projects to address this pressing challenge.

2020 serves as a great goal post for HKRITA on one hand to support Hong Kong’s athletes and raise the profile and competitiveness of our apparel industry in performance apparel and at the same time contribute to our industry’s very real technology needs to become a green industry and operate in a manufacturing environment that has greater needs for automation and a higher degree of transparency.

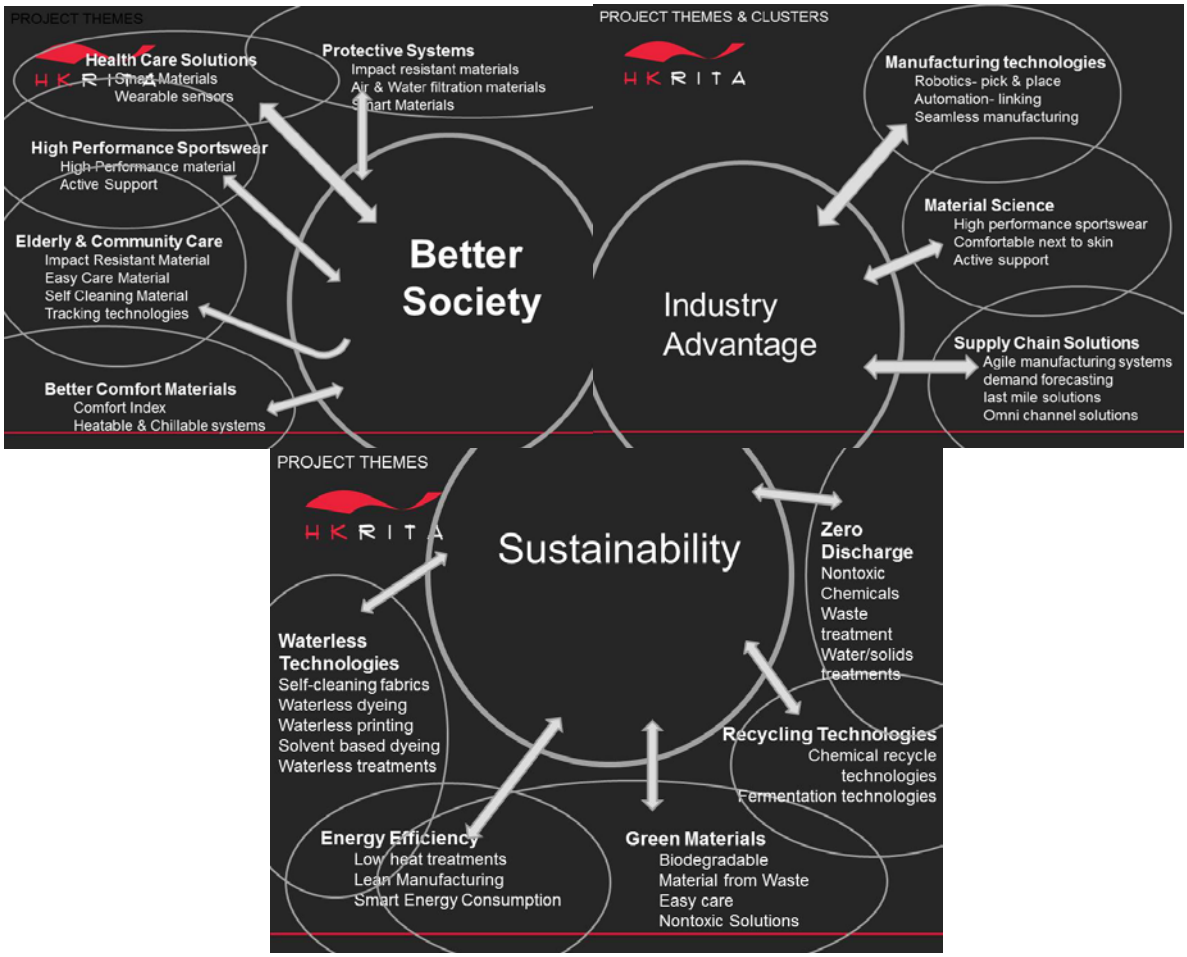
The Race is On – 2015 and Beyond

In the years ahead, the need for transformation, innovation, and disruption continues for our industry and society. HKRITA cannot be complacent or not grow with the times. At the same time it sees significant opportunities for Hong Kong to play a major role in the leading edge of new applications for textiles and apparel. HKRITA sees the industry transform from a manufacturing source to an innovation hub.

Rapid commercialisation of outcomes, dominance of select technology domains, and critical mass in the impact of research project are all necessary ingredients for HKRITA to contribute to the success of the textile and apparel industries in Hong

Kong. It is keenly aware of the time bound nature of this challenge and as such feel a tremendous sense of urgency to be as productive as quickly as possible.

Today HKRITA already has specific projects in design and development to drive its research focus and agenda for the coming years. These clusters build on one another to strengthen and enhance HKRITA's current and future efforts.



2. Commercialisation and Technology Transfer to the Industry

With its R&D focus on the themes of Sustainability, Industry Advantage and Better Society, HKRITA is promoting its technologies of providing solutions to industry for zero discharge, waterless technologies, energy efficiencies, and to facilitate manufacturing technologies so as to enhance the efficiency throughout the supply chain to drive competitiveness.

Highlights of its commercialisation plan under several major HKRITA projects are as follows –

(a) <u>Imaging Colour Measurement (ICM) System for Textile and Garment Industry</u>

The project is an innovative and technological breakthrough in the measurement of colours in various materials, such as printed fabrics, three-

dimensional lace structures, yarn dyed materials, etc. using an imaging capturing process. The project has obtained strong interest from the industry. HKRITA will work closely with its project teams to formulate a business strategy to commercialise the technology to maximise the benefit to the industry.

(b) Bio-degradable Synthetic Fibres

This project developed disposable and degradable synthetic fibres for the textile industry. These are from non-plant based oxo-biodegradable materials. The project focused on synthetic fibres such as polyester and polyamide. The biodegradation process is initialised by the synergistic interactions among two or more transition metals. The developed fibres are able to alleviate the environmental problems caused by waste disposal of synthetic polymers

(c) Fabric Touch Tester (FTT)

HKRITA has been promoting this tester though different marketing channels. It is over-whelmed by the number of inquiries received with regards to this technology and its application. In order to make the technology available and benefit global users, its project team is working on an international standard of the Fabric Touch Tester to fulfil industry need.

3. Application of R&D Outcomes in the Public Sector and Benefits to the Community

Public Sectors Trial Scheme (PSTS) projects are derived from completed and successful platform and collaborative projects, which are ready to commercialise to local industry. HKRITA continues to have multiple trials of its projects in various non-profit organisations, government departments, and community group. It aims not only to benefit our community, but also quickly demonstrate its project impact and look for opportunities for improvements. Last year, HKRITA has initiated 13 new PSTS projects.

The total number of completed platform and collaborative projects up to 31 March 2015 was 63 of which, some required further enhancement of the prototype produced in order to meet the industry's need and respective requirements for further development/ future commercialisation. In this respect, HKRITA has put more efforts in conducting PSTS projects to shorten the commercialisation period of the completed projects for industrial application.

Public organisations and Government departments such as Tung Wah Group of Hospitals, Marine Division of HKPF and Hong Kong Sports Institute have collaborated with HKRITA on trial tests of project deliverables on health care textiles, effective tracking system for elderly, functional garment, high performance sportswear, etc.

PSTS will continue to be one of the focuses of HKRITA's work.

4. Promotion Activities and Liaison with Stakeholders, Including Local and International Collaboration

Looking ahead HKRITA's marketing priority will be to complement its R&D efforts to generate industry interest in the deliverables of completed projects. HKRITA will continue to organise and support various seminars and workshops with different organisations such as Hong Kong Trade Development Council, other research centres, local and international universities, and other international institutes to promote its research and development programme to the industry and explore collaboration opportunities with research partners. HKRITA will also organise and participate in international trade shows or technology fairs to publicise its commercialised technologies. It plans to continue its participation in events like InnoCarnival, Inno Desgin Tech (IDT) Expo, Hong Kong Fashion Week and various other important international events.

HKRITA published its first Centre Report in 2014 with much success. It aims to continue to publish with regularity. Along with these HKRITA will continue to produce specialised materials for specific projects or for special events.

Other major communication channels adopted by HKRITA includes –

(a) A new mobile app to provide a user-friendly interface for mobile communication. Projects information and the latest news and events of HKRITA can be easily access via mobile device;

(b) HKRITA's enhanced website (www.hkrita.com) in English and Chinese. To-date there have been around 300,000 visits to its website;

(c) Its e-newsletter will continue to be published on a quarterly basis. This will have articles on projects as well as news on current industry matters; and

(d) Its electronic direct mailing to enable fast and efficient communication with industry partners.

5. Budget and cash flow

The current approved commitment for the operation of HKRITA up to 31 March 2017 is $197.7 million. To support its continued operation up to 31 March 2021, an additional funding of $146.8 million is required for HKRITA, bringing the total funding commitment for 15 years of operation to $344.5 million.

Operating Expenditure (in $ million)

	5-year Cumulative 2006-07 to 2010-11	4-year Cumulative 2011-12 to 2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total
	(Actual)	(Actual)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	
Staff [(1)]	36.3	53.8	18.0	20.5	23.1	24.9	27.3	29.8	233.7
Accommodation [(2)]	1.8	7.5	3.2	3.8	3.8	4.0	4.0	4.1	32.2
Equipment and other capital cost[(3)]	2.5	1.5	1.4	1.6	0.3	0.3	0.3	0.3	8.2
Commercialisation[(4)] (including publicity, marketing, etc.)	2.5	9.3	3.3	3.4	3.5	3.6	3.7	3.8	33.1
Others[(5)]	3.9	8.2	3.9	4.5	4.8	4.8	5.1	5.3	40.5
Total expenditure:	47.0	80.3	29.8	33.8	35.5	37.6	40.4	43.3	347.7
Less: Admin. overheads[(6)]	-	-	0.1	0.2	0.4	0.6	0.8	1.1	3.2
Total operating cost from ITF :	**47.0**	**80.3**	**29.7**	**33.6**	**35.1**	**37.0**	**39.6**	**42.2**	**344.5**

Explanatory Notes –

(1) Staff cost covers basic salary, Mandatory Provident Fund contributions, contract-end gratuity, medical insurance, etc. The staff establishment of HKRITA is forecast to reach 43 posts by 2020-21.

(2) Budget is earmarked for rental of an office at the Hong Kong Science Park (HKSP) from 2015-16 onwards for carrying out centre-owned R & D projects.

(3) Provisions ($1.1M and $0.8M) are made in 2015-16 and 2016-17 for expenditure on renovation of new offices at the HKSP and The Hong Kong Polytechnic University to accommodate new project staff recruited.

(4) HKRITA plans to step up its commercialisation efforts from 2015-16 to promote research deliverables of both commercialised projects and projects to be commercialised. The budget mainly covers expenditure for exhibitions, production of prototype as well as publicity and advertisements.

(5) Other miscellaneous cost items include human resource management related expenses, IT programming and maintenance fees, professional fees, utilities expenses etc.

(6) The administrative overheads received from in-house R&D projects conducted by HKRITA will offset the operating cost involved in supporting these projects.

R&D Projects and Expenditure (in $ million)

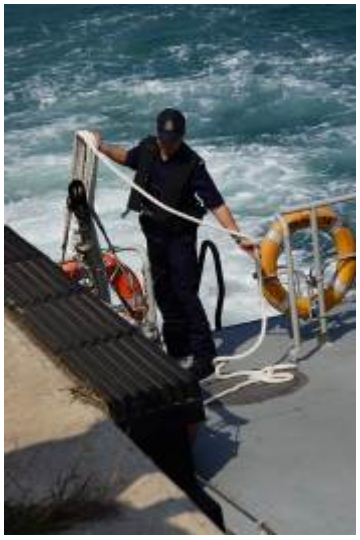
	5-year Cumulative 2006-07 to 2010-11	4-year Cumulative 2011-12 to 2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total
	(Actual)	(Actual)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	
No. of new projects commenced	51	83	30	32	34	36	38	40	344
No. of projects under commercialisation(1)	7	42	49	56	64	72	81	90	n/a
R&D expenditure ($ million)	98.0	157.6	75.0	85.0	89.0	94.0	101.0	108.0	807.6

Explanatory Notes –

(1) Completed or on-going projects with technologies ready for commercialisation such as licensing and filing of patents.

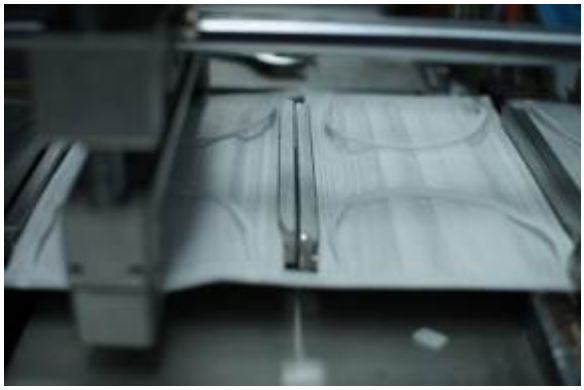
PART 5 – PROGRESS OF SELECTED PROJECTS ON R&D, COMMERCIALISATION AND USE OF R&D OUTCOMES IN THE PUBLIC SECTOR IN 2014-15

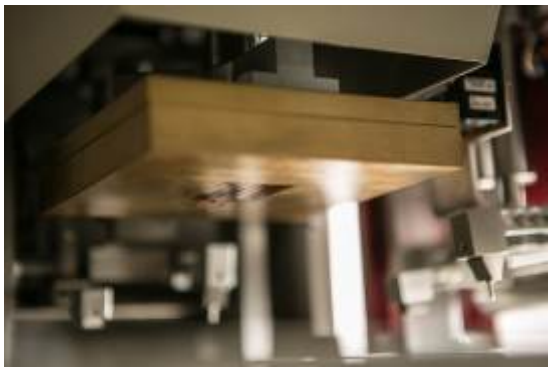
Project / Technology	Status / Progress
Development of Smart Interactive Functional Clothing(High Performance Rowing Suits)  	This project was in collaboration with the Hong Kong Sports Institute (HKSI) and completed on 12 December 2014. HKRITA developed 200 sets of high performance rowing speed suits for the Hong Kong Rowing Team participating in 2014 Asian Games. The HKSI Head Rowing Coach commented that the rowing suits were extremely comfortable under race conditions and its exquisite design enhanced the team's group identity, spirit and performance. A silver medallist appreciated the lightness design of the sportswear which has significant support from our athletes, especially our lightweight sportsman and sportswomen. Hong Kong Rowing Team won its first-ever gold medal and four silver medals to the Hong Kong Rowing Team in the Asian Games. Moreover, the team placed third in the overall medal table in rowing out of 19 countries.

Project / Technology	Status / Progress
Uniform of Marine Division of HKPF - Fabrication of Durable Surface-Cooling Fabrics by Binder-Free Finishing Technology  	This PSTS project, commenced on 2nd January 2015, aims to apply the surface-cooling finished technology developed from a completed collaborative project to the working uniforms of the Marine Police force, including shirts and trousers for year-round use. Approximately 220 sets of the working uniforms finished with the surface cooling technology will be produced. Fabric of the uniforms with cooling sensation will be developed which is expected that the finished working uniforms will provide better comfort to the Marine Police officers during hot and humid summer conditions.
Uniform of Marine Division of HKPF – High Performance Sportswear and Devices 	With the development of the high performance sportswear design and engineering technology from the completed Platform Project "High Performance Sportswear and Devices" and the support from the Marine Division of HKPF, this PSTS project, commenced on 1 March 2015, aims to engineer 370 sets of next-to-skin thermal protective garments, including a long sleeve pullover and pants, for the Marine Division of HKPF during operation under the chilly windy conditions in winter. It is expected that the thermal protective garments will provide thermal comfort and quick dry functions to Marine Police officers working under harsh weather conditions at sea on open deck ships.

Project / Technology	Status / Progress
Better Quality Community Care of the Elderly    	This project aims to develop comfortable outerwear apparel and an apparel-based tracking system for elderly with brain degenerative illnesses such as Alzheimer patients. This project is conducted by a coalition of three R&D Centres in Hong Kong: HKRITA, ASTRI & LSCM. The tracking system alerts care givers when patients wandering away from their care setting. The project also had to be done in a cost affordable manner for care centres, and the patients receiving home care. The six-month project was completed on 30th September 2013. 620 vest prototypes embedded with RFID tags have been produced. The system generates an audible alert to inform the staff of the elderly centres if a patient leaves the centres through the exits monitored by the system. A field trial with about 140 patients was completed in two day-care elderly centres of Tung Wah Group of Hospitals (TWGHs). An enhanced version has been further developed. The project was commenced in November 2014. The new system provides tracking functions covering indoor and outdoor environments. The outerwear apparel is made of Nu-Torque cotton yarn embedded with GPS tracker and Bluetooth Low Energy (BLE) devices. Trials will be conducted in a day care centre of TWGHs.

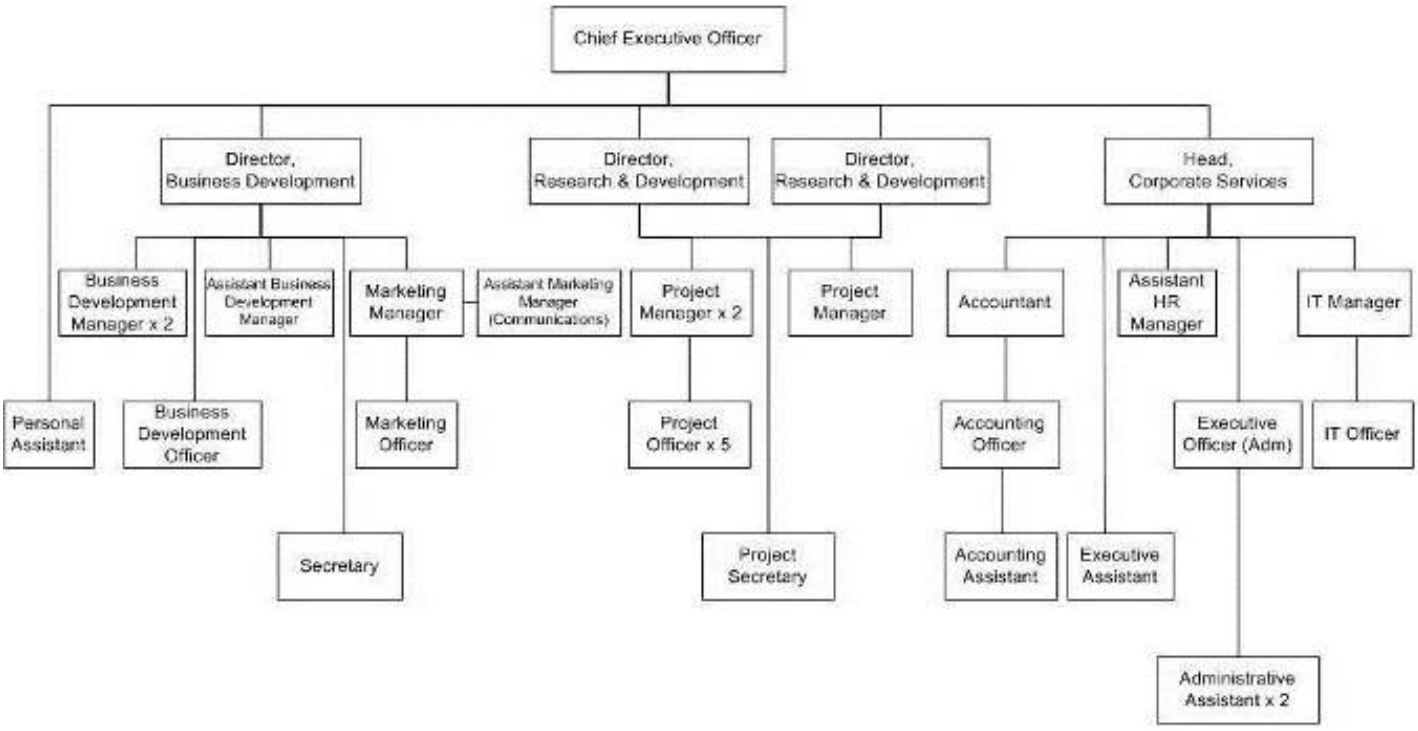
Project / Technology	Status / Progress
Image Colour Measurement (ICM)  	The ICM system provides a total solution for the textile and apparel industry when meeting rigorous standards of color management. The system can measure multi-colored fabric samples with different sizes, regular or irregular shapes, and different textures in an accurate and objective manner. HKRITA is now developing the third-phase project (ICM-III) which is mainly aimed at developing a next level of spectral color measurement system and achieving a further improved precision, accurate and repeatable color measurement of varieties of fabrics with complex color and pattern combinations, while offering an objective color assessment in the color quality control systems of retailers, suppliers, manufacturers, and buyers. With the fully integrated optical system, compact and modular hardware arrangement, and optimized software design based on the second-phase ICM system, the ICM-III system will be ready for industry application. The technology won a Gold medal at the 41st International Exhibition of Inventions of Geneva in 2013. It is planned that the ICM-III will be developed in March 2016.

Project / Technology	Status / Progress
Bio-degradable Synthetic Fibres  	This project, completed on 31 July 2014, developed a metal chelating technique to stabilize metallic pro-oxidants for degradable fibers with a controllable shelf life. Novel recipes for three popular synthetic fibers (polyester, polyamide and acrylic) have been formulated. A volume of degradable masterbatches were produced by using a twin-screw system with vacuum drying chamber. The degradable synthetic fibers can be fabricated by a melt spin system. In addition, a control mechanism for producing degradable fibers with engineered life span has been developed. Producing degradable polyester, polyamide and acrylic synthetic fibers would be the first of its kind in the textile industry. The major focus area is the disposal plastic fibers and products. The project deliverables can be applied to textile and apparel, medical and personal healthcare, as well as packaging and environmental industries using disposal plastic products. The technology won a Gold medal with jury's commendation at the 43rd International Exhibition of Inventions of Geneva in 2015

Project / Technology	Status / Progress
Development of Professional Software for Fabric Touch Tester  	The Fabric Touch Tester is a breakthrough in the area of fabric hand feel evaluation. While fabric hand-feel evaluation systems exist in the market today, they are not widely adopted by the industry due to their complexity in measurement and the lack of recognised testing standards. The Fabric Touch Tester provides an objective evaluation system with a user-friendly interface to measure fabric hand feel. The software of Fabric Touch Tester has further developed which is able to provide objective data of different textiles production, e.g. manufacturing of intimate apparel or outerwear. The speed of measurement is faster and the data is more in-depth and relevant to specific manufacturer. Since project commencement, HKRITA has been working closely with one of the leading global testing equipment manufacturers from the US. A non-exclusive licence agreement was signed with the manufacturer in 2013 and six testers have already been sold in 2014. The technology won a Gold medal with the congratulations of jury at the 41st International Exhibition of Inventions of Geneva in 2013.

Appendix

Organisation Chart of HKRITA



Excluding 2 R&D staff (against an establishment of 6) employed under ITF projects.

Annex D

Comprehensive Review on R&D Centres 2015

Hong Kong R&D Centre for Logistics and Supply Chain Management Enabling Technologies (LSCM)

A video featuring selected achievements of LSCM is available at the following link –

https://www.youtube.com/watch?v=jb8bAUxotAY

PART 1 – HIGHLIGHT OF OPERATION IN 2014-15

I. New R&D Projects and Industry Contribution (in $million)

	2013-14			2014-15		
	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution
Platform	2	23.2	5.6 (23.9%)	6	41.2	4.9 (22.6%)
Collaborative	3	4.6	2.4 (52.7%)	1	9.9	5 (50.7%)
Seed	1	2.6	0.6 (24.1%)	-	-	-
Total:	6	30.4	8.6 (28.2%)	7	51.1	9.9 (31.4%)
Public Sector Trial Scheme	7	12.3	n/a	10	32.8	n/a

Note: *Figures in brackets denote the level of industry contribution.*

II. Operating Expenditure (in $million)

	2013-14	2014-15
Staffing	13.4	14.3
Accommodation	4.0	4.0
Equipment	0.4	1.0
Others	2.6	5.5
Total:	20.4	24.8

III. Industry Income Received (in $million)

	2013-14	2014-15
Sponsorship for projects	8.45	7.28
Licensing/Royalty	0.09	0.22
Contract Services	0.16	0.09
Others	-	-
Total:	8.70	7.59

PART 2 – GENERAL BACKGROUND

1. Mission and vision

The Hong Kong R&D Centre for Logistics and Supply Chain Management Enabling Technologies (LSCM) was founded in 2006 with a mission to foster the development of core competencies in logistics and supply chain related technologies and to facilitate the adoption of these technologies by industries in Hong Kong and Mainland China. The major technology focus areas of LSCM include –

(a) Infrastructure Information Technology System;
(b) Internet-of-Things (IoT) and RFID Technology;
(c) Location-based Service (LBS) Technology;
(d) Logistics and Supply Chain Analytics and Applications; and
(e) Supply Chain Security.

2. Institutional set up

LSCM is set up as a non-profit-making company, jointly owned by its hosting organisations, namely the University of Hong Kong, the Chinese University of Hong Kong and the Hong Kong University of Science and Technology.

The Board of Directors of LSCM oversees the operation and development of the R&D Centre. It is underpinned by –

(a) a Technology Committee, which is responsible for advising on project proposals and related issues; and

(b) a Finance and Administration Committee, which is responsible for advising on and overseeing all administrative matters.

LSCM has also put in place an Internal Audit (IA) mechanism. IA reports are submitted to the Finance and Administration Committee.

LSCM is required to prepare annual plans and quarterly/annual reports on its operation and submit them to the Commissioner for Innovation and Technology for approval.

3. Organisation

As of 31 March 2015, the staff headcount of LSCM is 58, against the budgeted establishment of 70, including the Chief Executive Officer. The organisation chart is at Appendix.

PART 3 – EVALUATION OF THE PERFORMANCE OF THE R&D CENTRE FROM 2011-12 TO 2014-15

1. R&D Achievements

The performance of LSCM during 2011-15 has been marked by considerable improvement, when compared with its first 5 years of operation. During the period, 48 projects have been commenced, which compares favourably to the 29 projects in the first five-year period of Centre operations. LSCM's overall level of industry contribution in 2011-15 was 23.5%, which was significantly higher compared to the 12.3% of industry contribution during its first five-year period. It is also encouraging to see the significant increase of collaborative projects from 2 in the first five-year period to 7 during the 2011-15 period.

LSCM has sustained its healthy growth rate in 2014-15 by commencing 17 new projects in 2014-15 (up from 13 projects in 2013-14). It also achieves 31.4% of industry contribution representing the highest one since the establishment of the Centre in 2006.

LSCM is also keen to build up its technological capability in focused areas. For instance, Location-Based Services (LBS) technologies have emerged as a key enabling technology for positioning, tracking, or other personalized applications. In order to improve the competitiveness of local industry by harnessing the applications of LBS, LSCM has, in collaboration with more than 10 professors from six local universities, initiated multiple projects to advance the state of the art, including both indoor and outdoor navigation, Wi-Fi, cellular, and satellite-based approaches, active and passive RFID positioning, etc. The latest advancements in these LBS technologies are bringing about major improvements in accuracy, reliability and for services that can be deployed in both the private and the public sectors.

As a result of the LSCM's continued commitment to supporting local adoption of its technological offerings, a local hospital has adopted LSCM's Babytag and monitoring system in its new infant ward; Hong Kong International Airport (HKIA) has participated in the pilot use of WiFi-based navigation and novel indoor GPS system; and the Air Mail Centre of Hongkong Post has commissioned the use of an active RFID positioning platform to track its parcel carts in its cargo handling centre. As a result of the combined efforts of its stakeholders, LBS technologies are increasingly being deployed in critical infrastructures.

2. Commercialisation and Technology Transfer to the Industry

In terms of commercialisation of R&D results, LSCM's performance is trending upwards. During the 2011-15 period, LSCM signed 42 licensing agreements, compared with 1 signed licensing agreement accounting for its first five-year period.

In 2014, LSCM developed and showcased its tamper-resistant and reusable baby tag technology in a local hospital, which subsequently attracted the interest of two local companies, each of which have since licensed the Babytag technologies in order to support their business expansion for infant tracking solutions in the Hong Kong and China markets. One of these companies has been further awarded a contract to provide the baby tracking system to a local private hospital.

Additionally, LSCM endeavors to create market awareness for its technologies by leveraging ITF funding schemes such as the Public Sector Trial Scheme (PSTS). This is exemplified with LSCM's RFID Reader IC Chip design, which LSCM promotes its commercialisation by partnering with a local RFID company through ITF collaborative project scheme to productize the chip and push its adoption into the marketplace. Furthermore, the Centre also creates industry-driven applications for the RFID reader by utilizing LSCM chip as a backbone for developing PSTS projects. So far, four PSTS projects have been launched in connection with the RFID reader:

1) Reader for Airport Home Printed Luggage Tags;
2) Tree Reader for Hong Kong Housing Authority;
3) Walking cane with embedded RFID reader for Hong Kong Society for the Blind (HKSB); and
4) Multi-purpose reader for smart community care applications.

3. Application of R&D Outcomes in the Public Sector and Benefits to the Community

With the support of more than 40 Government bureaux/departments, public bodies, and industry/trade associations, the Centre has commenced work on a total of 24 PSTS projects since its establishment. Through its collaborative efforts, LSCM has worked with each of its partners to better understand their needs, match them with suitable technologies and support their adoption. In so doing, LSCM aims to facilitate cross-sector collaboration in projects which benefit a wider community for Hong Kong.

Currently, LSCM collaborates with the following government/public organisations:

Government bureaux/departments:
Commerce and Economic Development Bureau, Transport and Housing Bureau, Development Bureau, Food and Health Bureau, Home Affairs Bureau, Security Bureau, Customs and Excise Department, Hong Kong Police Force, Correctional Services Department, Housing Department, Hong Kong Housing Authority, Buildings Department, Civil Engineering and Development Department, Lands Department, Highways Department, Leisure and Cultural Services Department, Hongkong Post, Food and Environmental Hygiene Department, Radio Television Hong Kong.

Public bodies:
Hong Kong Logistics Development Council (LOGSCOUNCIL), Airport Authority Hong Kong, Hong Kong Monetary Authority, Construction Industry Council (CIC), Hong Kong Trade Development Council (HKTDC), Tung Wah Group of Hospitals, The Hong Kong Council of Social Service, Hong Kong Housing Society, Occupational Safety and Health Council.

Non-profit organisations and trade associations:
Hong Kong International Airport Carrier Liaison Group, Hong Kong Private Hospitals Association, Hong Kong Society for the Blind, GS1 Hong Kong, Hong Kong Construction Association, Hong Kong Institute of Construction Managers, Hong Kong Retail Technology Industry Association, Hong Kong Food Council.

With a sustainable growth strategy in place, as well as ITC's policy to intensify efforts to promote the application of R&D outcomes in the public sector, the Centre has great potential for fostering more collaboration opportunities between the public sector and the Centre and transferring R&D results to the private sector.

4. Promotion Activities and Liaison with Stakeholders, Including Local and International Collaboration

In 2013-14, LSCM was appointed as an institutional member of the LOGSCOUNCIL in recognition of its knowledge and expertise in the logistics industry.

Apart from serving in LOGSCOUNCIL, LSCM also serves as the member of Airport Authority Hong Kong's Technology Advisory Council; the member of CIC's Task Group on Application of Innovative Design to Enhance Construction Safety; and the member of HKTDC's Logistics Advisory Committee.

The Centre has also built a close relationship with logistics and trade related associations and organisations. LSCM is members of the following associations:

Hongkong Association of Freight Forwarding and Logistics, Hong Kong Logistics Association, Hong Kong Sea Transport and Logistics Association, Chartered Institute of Logistics and Transport, Hong Kong Electronics & Technologies Association, Hong Kong Electronic Industries Association, Hong Kong Electronics Industry Council, Federation of Hong Kong Industries, Chamber of Hong Kong Logistics Industry.

During 2011-15, LSCM has continued to reach out to promote itself to various sectors and industries in Hong Kong. An increasing awareness of LSCM is demonstrated by feedbacks from a series of LSCM's events including LSCM Logistics Summits (2012, 2013 and 2014) and the LSCM Logistics Roadshow (February 2013 and 2014, and April 2015). As a result, LSCM has been able to forge partnerships with many new industry partners.

5. SWOT Analysis

A Strength-Weakness-Opportunity-Threat (SWOT) Analysis of the development of LSCM is set out below –

Strengths	Weaknesses
1. Wide and deep partner/customer base 2. Close relationship with industrial community and public bodies 3. Broad and strong technology focus 4. Good standing in technology field: - The most experienced research institute designing RFID tag antenna and the only institution that has designed and manufactured a RFID Reader IC chip in China - One of the leading IoT research institutes in Hong Kong - The biggest technology institute closely related with logistics industry in Hong Kong - The central hub of LBS research in the region	1. Need faster responses to quickly changing market challenges 2. Lack of manufacturing partners in Hong Kong to provide support 3. Gap exists between research results and commercialisation - need further trial and developmental engineering program 4. Cooperation model among LSCM, academia, government and industry is improving but still work in progress 5. Continuous effort needed to command trust and faith of industries - albeit rapidly improving
Opportunities	**Threats**
1. LSCM's IoT researches would bear significant impact to future industrial development – Logistics & Supply Chain, E-commerce, E-Services, Construction, Retail, Hospital, Hotel, etc. 2. Offering of enabling technologies (Big Data Analytics, Robotics, etc) can help Hong Kong logistics industry transform from a geography-based to intelligence-based model 3. LSCM's LBS Technology will put Hong Kong in leading position in Global Navigation Satellite System accuracy 4. Help propel Hong Kong's advancement in becoming a truly Smart City	1. Insufficient resources to attain critical mass 2. Insufficient participation and support of universities 3. Monopolisation of key technologies by foreign companies 4. Limited supply of technology human capital in Hong Kong

PART 4 – FUTURE PLAN OF THE R&D CENTRE FROM 2017-18 TO 2020-21

1. Technology roadmap and R&D programme

According to the report from HKTDC, as one of the four pillar economy sectors in Hong Kong, the trading and logistics industry employs over 770,000 employees and accounts for a quarter of GDP in terms of value added in 2013. With the “Belt and Road Initiative" promulgated by the Central Government, Hong Kong, as a transportation and logistics hub in the heart of Asia, will surely be given a unique role. However, the traditional logistics industry is currently faced with severe challenges and competitions from neighbouring regions.

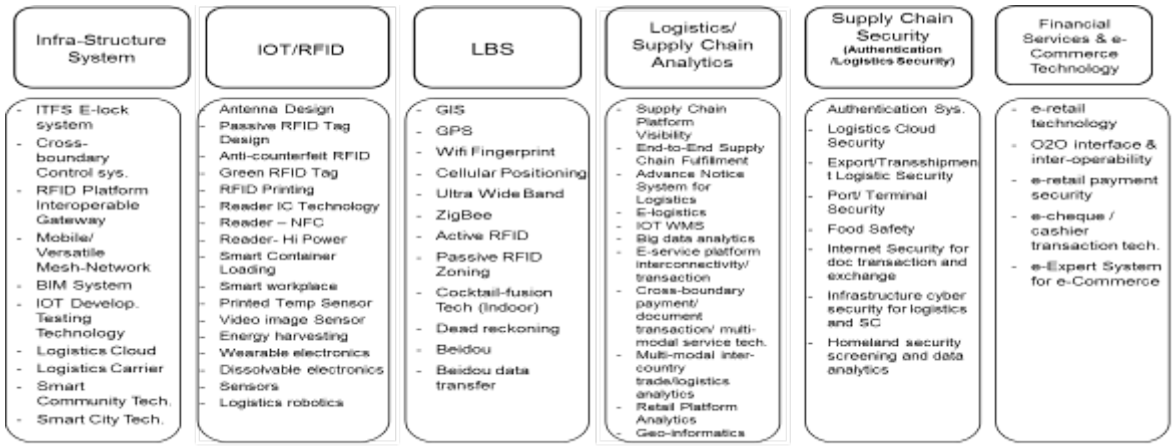
The flourish of e-commerce brings lots of challenges to traditional business. In order to maintain Hong Kong’s competitive edge, the logistics and supply chain industry has to develop into an “Intelligent-based model” in order to sustain and thrive in the dynamic business environment. LSCM is well-positioned to help the logistics and supply chain industry to adopt innovation and technology to enhance efficiency in different levels to achieve the best possible results.

Technology Roadmap

In 2014-15, LSCM has initiated discussion with its Board and expert panelists on its Technology Roadmap. LSCM is targeted to broaden and strengthen its core technological competency in the following technology areas –

(a) Infrastructure Information Technology System;
(b) Internet-Of-Things (IoT) and RFID Technology;
(c) Location Based Service (LBS) Technology;
(d) Logistics and Supply Chain Analytics/Applications;
(e) Supply Chain Security and
(f) Financial Services & e-Commerce Technology.

LSCM will, based on this enhanced roadmap, develop demand-driven R&D projects, with an emphasis on providing innovative solutions to enable its clients, in particular small and medium sized enterprises (SMEs), to move up the value chain.



2. Commercialisation and Technology Transfer to the Industry

LSCM has experienced success in achieving market penetration for its RFID tags and RFID reader devices in the airport, wine, construction, retail, and social welfare sectors. Furthermore, LSCM's efforts in marketing its BabyTag technology has drawn significant amounts of interest for adoption from both local and Mainland companies.

Similarly, LSCM's SMe-plug technology has taken advantage of Hong Kong Productivity Council's Jumpstart Program and is now connected to 4 major logistics IT platforms to help service SMEs. LSCM has also maintained its presence on the Construction Industry Council's Task Group on Application of Innovative Design to Enhance Construction Safety as part of its role in promoting safety and identifying practical technology solutions for the commercial use of its RFID technology.

Looking forward, LSCM's key strategies in promoting commercialisation include the following –

- Strengthen the "sell-through" programme with system integration (SI) partners
- Engage industry partners for projects as a technology transfer strategy
- Extend to Mainland market -

In the coming years, the Centre will continue to build on its relationship with SMEs in order to identify practical technology solutions based on its R&D results for commercialisation.

3. Application of R&D Outcomes in the Public Sector and Benefits to the Community

LSCM aims to maximize the benefits of its research outputs for our local community. As of May 2015, LSCM has conducted 24 PSTS projects. It has collaborated with

several Government Departments, non-profit organisations, and community groups. With more projects coming to fruition, the top priority will be to push for the realization and commercialisation of R&D deliverables.

LSCM has positioned itself to take on an active role in facilitating the Government's policy drive. For instance –

Smart City initiative - LSCM will leverage IoT and LBS technologies such as its RFID, sensor networks, Indoor/outdoor positioning and navigation etc. to promote better public services for citizens, better use of resources and smarter municipal management.

E-commerce and Financial Technology (FinTech) initiative – Riding on the foundation of e-lock, SME-plug, and other e-transaction technology and the close partnership with the Government and regulatory body, LSCM will strengthen its effort to the development of e-logistics, e-Commerce and financial and other related technology in order to innovate and sustain new business opportunities brought from the era of e-commerce and financial technology.

"Belt and Road" – The initiative aims to promote connectivity in infrastructure, resources development, industrial co-operation, financial integration and other fields along the Belt and Road countries. Hong Kong is one of the world's leading logistics hubs. It is also an established international financial centre and the premier offshore RMB business centre. With multi-currencies (HKD, RMB, USD) support, e-Cheque readily facilitates e-Transactions/Payment in the Belt and Road Initiative. International corporations having cheque accounts with banks in Hong Kong can innovate new business models and settle transactions. Together with e-Commerce and various FinTech services stakeholders, Hong Kong could become the central hub of e-Commerce distribution and fulfilment.

Construction Innovation, and Safety Enhancement – With the 10 major infrastructure projects reaching their peak periods of construction, the squeeze is on in terms of productivity, manpower, workers' safety, and quality. LSCM will continue to support CIC and stakeholders of construction supply chain to alleviate these pressures by leveraging LSCM technologies such as IoT and LBS technologies.

Social and Elderly Care Services – While Hong Kong enjoys one of the longest life expectancies in the world, we are also facing the challenges that it brings to the society. LSCM will engage and collaborate with different organisations to solicit input and explore ways to promote the use of LSCM technology in improving the quality of life of the elderly as well as other people in need.

4. Promotion Activities and Liaison with Stakeholders, Including Local and International Collaboration

Since the establishment in 2006, LSCM has participated in over 400 promotional events all over the world. To increase the awareness of its identity, LSCM has organised and will continue to organise a series of events including the LSCM Logistics Summit, LSCM Logistics LSCM Roadshow, etc.

By leveraging LSCM unique position as a liaison among the Government, industry, academia and research sector, the Centre has been able to act as a platform for its stakeholders and create opportunities for collaboration by bringing together many interested parties. With the positive momentum gained, LSCM is well positioned to support the logistics and supply chain industry going forward by building on the foundation laid down by its efforts in the past few years.

5. Budget and cashflow

The current approved commitment for the operation of LSCM up to 31 March 2017 is $207.9 million. To support its continued operation up to 31 March 2021, an additional funding of $154.5 million is required for LSCM, bringing the total funding commitment for 15 years of operation to $362.4 million.

Operating Expenditure (in $ million)

	5-year Cumulative 2006-07 to 2010-11	4-year Cumulative 2011-12 to 2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total
	(Actual)	(Actual)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	
Staff [(1)]	41.4	50.7	18.0	18.6	21.3	23.0	24.8	26.6	224.4
Accommodation [(2)]	8.7	15.5	4.5	4.5	5.4	5.4	5.7	6.5	56.2
Equipment and other capital cost	3.7	2.4	1.0	1.0	1.1	1.2	1.3	1.4	13.1
Commercialisation[(3)] (including publicity, marketing, etc.)	3.4	12.5	4.1	4.3	4.7	5.2	5.7	6.3	46.2
Others[(4)]	13.8	9.1	3.4	3.5	4.1	4.6	5.2	5.8	49.5
Total expenditure:	71.0	90.2	31.0	31.9	36.6	39.4	42.7	46.6	389.4
Less: Admin. overheads	6.7	5.0	2.0	2.5	2.3	2.6	2.9	3.0	27.0
Total operating cost from ITF :	**64.3**	**85.2**	**29.0**	**29.4**	**34.3**	**36.8**	**39.8**	**43.6**	**362.4**

Explanatory Notes –

(1) Staff cost covers basic salary, Mandatory Provident Fund contributions, contract-end gratuity and medical insurance, assuming inflationary and salary adjustment of 5% per annum. Subject to CIT's approval for individual projects, the staff establishment of LSCM is forecast to reach 98 posts by 2020-21. Staff cost for individual R&D projects as part of project expenditure will be funded by the Innovation and Technology Fund.

(2) The tenancy agreement for LSCM's existing premises in Cyberport will expire on 31 December 2016. We expect the rental cost from 1 January 2017 onwards will rise.

(3) LSCM will take a more proactive role in disseminating the R&D results and promoting commercialisation.

(4) The increase in other operating cost is mainly due to the Centre's continuous expansion of its research capabilities and development of its IP portfolio. As a result, the cost of maintaining and managing its intellectual property assets is projected to rise. Furthermore, other operating cost items including utilities, office expenses, legal & professional service fees, staff training, repair & maintenance fees etc., are expected to increase proportionally with inflation and Centre expansion.

R&D Projects and Expenditure (in $ million)

	5-year Cumulative 2006-07 to 2010-11	4-year Cumulative 2011-12 to 2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total
	(Actual)	(Actual)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	
No. of new projects commenced	29	48	19	21	23	26	28	30	224
No. of projects under commercialisation(1)	8	29	35	42	50	62	75	90	n/a
R&D expenditure ($ million)	139.4	164.1	56.0	58.8	69.5	75.1	81.1	87.6	731.6

Explanatory Notes –

(1) Completed or on-going projects with technologies ready for commercialisation such as licensing and filing of patents.

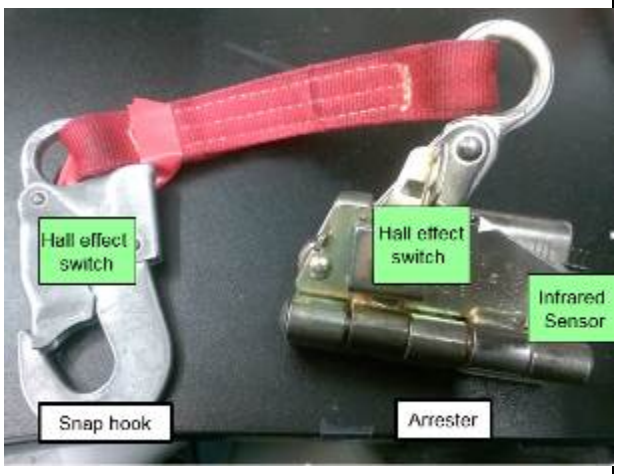
PART 5 – PROGRESS OF SELECTED PROJECTS ON R&D, COMMERCIALISATION AND USE OF R&D OUTCOMES IN THE PUBLIC SECTOR IN 2014-15

Project / Technology	Status / Progress
RFID-Enabled Sensing Technologies for Real-time Environmental Monitoring and Risk Management  *IoT device with positioning and communciation capabilities* *[Piloted by Hongkong Post's Air Mail Centre]*	The project has developed positioning readers, and tags for Air Mail Centre (AMC) of Hongkong Post to facilitate the real-time positioning of purple cart. The pilot and integration system with AMC's system have been successfully applied to the ports in Australia, Chicago in the United States and the United Kingdom in the pilot run since November 2014.  *IoT Reader installed in Hongkong Post's Air Mail Centre*

Project / Technology	Status / Progress
RFID Tags and Management System for tracking new born babies in hospital  *LSCM Babytag tested by infants*	The project was completed with pilot with real babies in a local hospital. The satisfactory result leads to licensing of LSCM baby tag system to local system integrator who successfully won the hospital tender.  *LSCM's Baby Tag*
Indoor Localization, Tracking and Navigation (Wayfinder)  *Mobile apps "Wherami" for indoor navigation*	Mobile apps "Wherami" for Hong Kong International Airport (HKIA), Cyberport, Olympian City and HKUST have been released on GooglePlay. Project team will enhance the apps as well as improve the total user experience for accuracy improvement and further adoption.

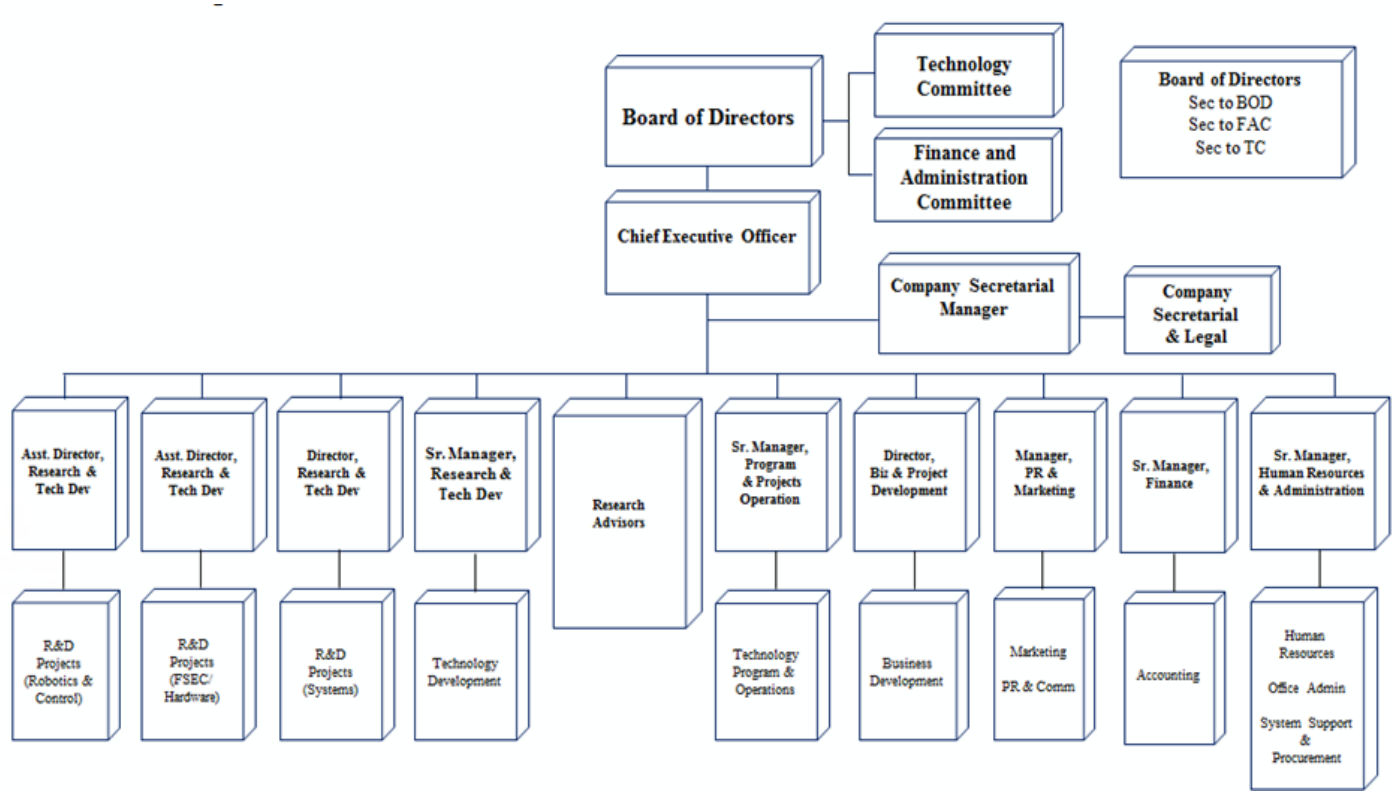
Project / Technology	Status / Progress
eTransaction Security for Hong Kong Monetary Authority  *E-cheque forum with HKMA, HKU, and LSCM*  *E-cheque image*	An e-cheque forum was successfully held on 19 December 2013 to disseminate the study of e-Transaction security schemes and methodologies. LSCM will continue to work with Hong Kong Monetary Authority to develop and promote the applications of e-Cheque and other e-transaction related technologies.

Project / Technology	Status / Progress
Lightweight RFID Reader Chip for NFC and Mobile Applications  *Strip Tag*  *LSCM low-cost reader integrated into a guiding cane*	The LSCM low-cost reader was integrated into the guiding cane to provide audible navigation information for the blind. It helps blind people identify places and navigate better both indoor and outdoor. Strip and block tags were installed at the Hong Kong Society for the Blind. A mobile application was developed for use with the RFID Reader Canes. The project team is currently conducting the on-site trial and collecting feedbacks from the users.
RFID-Enabled Building Information Modeling (BIM) Platform for Prefabrication Housing Production in Hong Kong  *RFID tags are tested under different deployed positions of the prefab components*	The project will apply RFID and Just-in-time concept for enhancing prefabrication production productivity. In collaboration with Housing Authority, a Tuen Mun construction site will first pilot the project from prefab item manufacturing, logistics and assembly processes.

Project / Technology	Status / Progress
An IOT System of Safety Belt Sensor and Risk Alert Mechanisms to Support Safety-at-Work Practice in Construction Sites  *On-site test*  *A RFID safety belt prototype*	The project develops an internet-of-things (IOT) system to provide real-time remote sensing of safety belts in construction sites. The deliverable can help to enhance the safety in construction sites. CIC will provide pilot sites for testing in August 2015.

Appendix

LSCM Organisation Chart



Annex E

Comprehensive Review on R&D Centres 2015

Nano and Advanced Materials Institute Limited (NAMI)

A video featuring selected achievements of NAMI is available at the following link –

https://www.youtube.com/watch?v=bTiXfn-nW9E

PART 1 – HIGHLIGHT OF OPERATION IN 2014-15

I. New R&D Projects and Industry Contribution (in $million)

	2013-14			2014-15		
	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution
Platform	2	3.2	0.4 (12.5%)	7	14.4	1.7 (12.1%)
Collaborative	4	6.4	3.5 (54.8%)	16	36.8	17.9 (48.6%)
Seed	8	15.0	n/a	12	33.3	n/a
Total:	14	24.6	3.9 (15.9%)	35	84.5	19.6 (23.2%)
Public Sector Trial Scheme	2	1.4	n/a	6	3.9	n/a

Note: Figures in brackets denote the level of industry contribution.

II. Operating Expenditure (in $million)

	2013-14	2014-15
Staffing	31.6	32.0
Accommodation	4.2	4.6
Equipment	12.1	5.9
Others	8.3	11.1
Total:	56.2	53.6

III. Industry Income Received (in $million)

	2013-14	2014-15
Sponsorship for projects	13.57	17.65
Licensing/Royalty	0.03	0.94
Contract Services	1.32	13.21
Others	-	0.11
Total:	14.92	31.91

PART 2 – GENERAL BACKGROUND

1. Mission and vision

The mission of NAMI is to serve as Hong Kong's platform for technology development in the areas of nanotechnology and advanced materials. In particular, NAMI will –

(a) identify and conduct innovative, market-driven R&D projects in collaboration with the local industry and research community; and
(b) drive the commercialisation of R&D outcomes.

2. Institutional set up

NAMI was established in 2006 as a non-profit-making company, wholly-owned by the hosting organisation, the Hong Kong University of Science and Technology (HKUST).

The Board of Directors of NAMI oversees the operation and development of the R&D Centre. It is underpinned by -

(a) a Technology Committee which is responsible for reviewing and endorsing project proposals;
(b) a Finance and Administration Committee which is responsible for advising on and overseeing administrative matters; and
(c) an Audit Committee which is responsible for overseeing the governance of NAMI, including internal audit.

NAMI is required to prepare annual plans and quarterly/annual reports on its operation and submit them to the Commissioner for Innovation and Technology (CIT) for approval.

3. Organisation

As at 31 March 2015, NAMI has a Centre staff strength of 52. In addition, it has 103 research positions under its R&D project teams. An organisation chart is at Appendix.

PART 3 – EVALUATION OF THE PERFORMANCE OF THE R&D CENTRE FROM 2011-12 TO 2014-15

1. R&D Achievements

Over the past years, NAMI has developed strong core competencies on nanotechnology and advanced materials. During the year 2014-15, NAMI had over 120 patents filed and has won awards in 2014 with its achievement on innovative technology, namely the Hong Kong Awards for Industries Technological Achievement Award (DAA) with its Die Attach Adhesive technology, and the Hong Kong Awards for Environmental Excellence Certificate of Merit with its Foam Concrete technology. NAMI's nanofiber platform technology has also led to healthcare applications and commercialisation.

NAMI has strived for a paradigm shift on research and business focus to substantially increase the demand driven collaborative researches with local enterprises to support them with technology upgrade. The outcome of the transformation is remarkable. In 2014-15, the number of research projects has substantially increased to 41 as compared with 16 in 2013-14, and the project costs from around $26M to $88.4M. The amount of industry sponsorship has also increased from $3.9M in 2013-14 to $19.6M in 2014-15.

2. Commercialisation and Technology Transfer to the Industry

NAMI believes that higher level of industry participation will increase success rate of commercialisation. Therefore, NAMI has adopted new proactive industry engagement and business development strategies in early 2014.

NAMI has significantly increased the number of collaborative research and contract research projects where the industry sponsors have clear plan to turn the technologies into commercial products. In addition, there are a total of eight successful technology licences during financial year 2014-15. These include two commercial licences and six Background Intellectual Property (BIP) licences. The two commercial licences are NAMI's water-based environmental friendly paint and photocatalytic oxidation technology. The former was licensed to a coating manufacturer for a special coating application and the latter was adopted by an indoor air quality equipment supplier to improve performance of their air purification system.

By leveraging intellectual properties created in previous projects, NAMI has established six BIP licences from either collaborative projects or contract research projects, which is beneficial to the industrial sponsors by shortening the project period, reducing R&D investment and risk in their collaborative research projects. The six licences are related to the following BIP –

(a) DAA to improve thermal management of plasma lighting;
(b) Printable temperature sensor technology to develop semi-conductor nano-inks for Thin Film Transistor backplane as well as a flexible, thin, waterproof and low cost temperature sensor;
(c) Foam concrete technology to develop light-weight hydrophobic cementitious sound barrier;

(d) Nano-calcium polymer technology to develop injectable calcium phosphate filler formulation for use as bone substitute in treating osteoarthritis cysts; and
(e) All-solution-processed metal oxide semiconductor technology to develop next generation thin film transistor.

3. Application of R&D Outcomes in the Public Sector and Benefits to the Community

NAMI has been taking an active role in promoting the use of R&D results in the public sector which will benefit the community. As at March 2014, NAMI has been implementing eight Public Sector Trial Scheme (PSTS) projects.

NAMI has applied a germicide-free and durable antibacterial coating for the facilities of a public hospital. Test results showed lifetime of the coating was at least 9 months without the need of replenishment after initial coating. To further extend the application of the coating, it has been applied to door handles at designated washrooms of Hong Kong Science Park (HKSP).

NAMI's nano-patch for the topical treatment of limb injuries has been applied to patients with soft-tissue or bone injuries in Hong Kong Polytechnic University's (PolyU) Sports Rehabilitation Centre. Efficacy data and users' comments collected will be used to support the product development process and to optimise the product specifications. The technology has been used as Background Intellectual Property by industry sponsors to develop other healthcare products.

Besides, NAMI is working closely with the Hong Kong Housing Authority (HKHA) to realise the application of NAMI's foamed concrete in buildings. Building of two demonstration rooms is underway, one using the foamed concrete and the other using normal concrete.

NAMI is also in close collaboration with Construction Industry Council (CIC) to evaluate the thermal insulation performance of NAMI's Thermal Insulation Coating. Collection of on-site data on various substrates such as steel, cement-based materials and fiber boards could create substantial job reference for potential customers.

With the support of the Highways Department, a demonstration unit of microalgae photobioreactor for air treatment has been installed at the Project Information Centre in the Tung Chung site office of the Hong Kong-Zhuhai-Macao Bridge Hong Kong.

With the support of Hong Kong Science and Technology Parks Corporation, NAMI's mirror-like coating and environmental paint have been applied on various facilities of HKSP, durability and users feedback could be promptly evaluated, which could facilitate further commercialisation.

Trial of NAMI's new micro-powder injection moulding process has demonstrated reduction in manufacturing cost and shortening of manufacturing time. Hong Kong Productivity Council (HKPC) and NAMI will jointly promote the technology to industries.

NAMI has worked with Hong Kong Critical Components Manufacturers Association (HKCCMA) to demonstrate its recent achievement in doped Nano-Lithium Titanate (LTO) battery technology with fast charging rate.

While NAMI is leveraging the Public Sector Trial Scheme projects to conduct the trial use of technologies, it is also actively promoting relevant technologies to the industries to encourage commercial adoption.

4. Promotion Activities and Liaison with Stakeholders, Including Local and International Collaboration

Over the past years, NAMI has increased the scope and intensity in promoting its technology competencies, research outcomes and commercialisation achievements. These included organising and participating in seminars, conferences, workshops, trade shows, etc. The NAMI showcase held in 2013 and 2014 respectively had received very good response from its collaborating partners, local research institutes and enterprises as well as the public, and had brought about many new collaborating opportunities. NAMI has also enhanced the dissemination of its technological development and ready-to-market technologies through a revamped website, new corporate video, product videos, regular press advertorials, etc. The membership drive had also been strengthened and the number of members recruited had increased to more than 1 900.

While NAMI encourages local universities to apply the funding support for research projects in advanced materials, NAMI also collaborates with local universities to jointly conduct research projects. Furthermore, professors from Polytechnic University, Hong Kong University of Science and Technology, City University and Chinese University of Hong Kong are invited to be NAMI's technical advisors to support its technology development.

NAMI also looks for leading research institute overseas and in the Mainland to strive for research excellence through partnering. NAMI is now working closely with Fraunhofer Institute for Silicate Research ISC, the leading German based applied R&D institute in material science in European Union, to develop research collaboration to support Hong Kong industries. Besides, NAMI has also established collaboration agreements with two leading research institutes in Mainland, namely the China Building Materials Academy and the Chinese National Engineering Research Center of Urban Environmental Pollution Control.

PART 4 – FUTURE PLAN OF THE R&D CENTRE FROM 2017-18 TO 2020-21

1. Technology roadmap and R&D programme

NAMI's technology roadmap will continue to evolve in the upcoming years to address the ever changing market dynamics in the market place. However, NAMI's overall goal will remain to develop nano and advanced materials based innovative products in its five focused market sectors –

– Sustainable energy;
– Solid state lighting, display and printed electronics;
– Construction / building materials;
– Environmental technologies; and
– Bio and healthcare sector.

With critical mass building up in each of NAMI's focused market sector, NAMI is developing core competencies in each sector that are capable of sustaining long term multi-product development partnership with its industrial sponsors. This can be achieved through the continuous development, refinement and improvement of various platform technologies in NAMI. These platform technologies can include the fabrication and formulation knowhow of advanced materials such as nano fiber and electronic inks as well as nano material surface treatment processing knowhow for various applications. The key objective is to achieve maximum leverage from its key technologies and knowhow to drive product commercialisation in multiple areas. The key development efforts in the five focused market sectors are:

Sustainable Energy

NAMI will stay focused on development of core competencies in Thin-Film Photovoltaic (TF PV) and Lithium Ion Battery (LIB) technologies. In TF PV, NAMI is working on novel low cost/high performance materials and low cost solution processing methods to lower the cost of energy generation. To provide a total solution to the LIB industry, NAMI is doing R&D on synthesis, simulation and modeling of new cathode and separator materials to complement the anode and electrolyte materials developed earlier and other specific requirements from sponsors. To allow wider acceptance of these technologies, NAMI is developing new applications such as flexible PV, flexible battery, safe battery and fast charge battery. NAMI is also working on energy saving R&D by developing new materials and processing methods that requires less energy. The major projects are –

– New materials and solution processing methods for high performance Organic flexible PV including Perovskite PV;
– New low cost and energy saving processing method for forming of Copper-Indium-Gallium target for CIGS TF PV and fiber-reinforced composite for asphalt;
– New materials and simulation & modeling for high capacity cathode materials; and
– Forming of new materials to extend the applications of LIB such as flexible, safe and fast charge batteries.

Solid State Lighting, Display and Printed Electronics

NAMI is developing different core technologies in the sector, and in the upcoming year we will focus first on thermal management materials and nano printing materials. In thermal management materials, NAMI is expanding the application of its successful Die Attach Adhesive material beyond high brightness Light Emitting Diode to high power lighting and also to electronic products where high power devices like RF devices are involved. NAMI also continues to develop innovative printed electronic materials for lighting, display, electronic and also 3D printing applications. One example is innovative semiconductor ink which is being patented and is being developed for different printed sensor products. NAMI is targeting the high growth flexible electronics and 3D printing markets. Other significant development directions include –

– Apply quantum dots to Light Emitting Diode and plasma lighting products as a replacement for phosphors and also to tune the optical spectrum for Liquid Crystal Display and grow light products;
– Continue to develop systematic modeling and simulation methodology to optimise materials and design to maximise light device efficiency; and
– Extend application of NAMI developed nanoparticle based printing materials to new areas like fabric and architectural products.

Construction / Building Materials

NAMI has identified opportunities for smart and sustainable building materials in four major focus categories, namely, energy saving materials, waste recycling, maintenance, and noise reduction. This initiative includes establishing a portfolio of technical knowhow to attract industrial partners to develop new products. Planned development includes –

– Development and commercialisation of superior thermal insulating foamed concrete and Volatile Organic Compounds-free cement-based coating for buildings pursuing energy saving. Alkaline activated cement with significant Carbon Dioxide reduction during the manufacturing will be developed for applications demanding rapid set;
– Waste material recycling for buildings is a high potential market for the sustainability of society. Strategic collaborations with industry partners will be pursued on fully utilising the cellulose-based waste materials including the extraction of lignin and cellulose fibres formation for buildings related applications. NAMI also collaborates with industry associations such as Construction Industry Council (CIC) to develop water seepage related repairing applications based on recycled plastics reinforced cementitious materials. Technologies to produce green sustainable lightweight aggregates based on incinerated wastes will be developed;
– Maintenance technologies under development include fabric reinforced cementitious matrix for buildings retrofitting, nano-particles reinforced polymer-cementitious coating with enhancement on elongation-at-break with waterproofing features, UV resisting polymeric coating for floor, etc; and
– Rubber concrete as underlayment floor to reduce the impact sound level and extend the applications of foamed concrete as sound barrier in roads.

Environmental Technologies

NAMI continues to develop new applications for the established core technologies of air purification, water purification and functional coatings. NAMI has also added the new area of advanced material processing which includes different sensing technologies as well as material recycling technologies. Some highlights of upcoming development areas include –

- Develop applications for its second generation plasma driven catalysis air purification technologies and also green algae technologies for large scale indoor and outdoor air purification;
- Continue to develop new applications of functional coating materials and technologies in industrial, consumer and architectural markets;
- Explore optical, electrochemical and advanced carbon material based sensing technologies for applications in sensing hazardous gases and chemicals, viruses and bacteria, and also different environmental parameters; and
- Develop different material recycling technologies to collaborate with local industrial partners in the area of plastics, metals and chemicals.

Bio and Healthcare Sector

A variety of technologies are needed to address this broad market which aims to improve the general health and well-being of mankind. NAMI plans to achieve this goal by investing efforts in three major thrusts as follows and work closely with industrial collaborators that will turn the technologies into meaningful products.

Prevention
The objects we touch and the air we breathe in are the two major sources that can affect our acute health. NAMI targets these two primary causes and develops products that can minimise cross contamination of contagious diseases. For contact disease prevention, NAMI continues to market its durable antibacterial coatings to device manufacturers as well as sanitiser providers in hygiene markets. For airborne transmission prevention, NAMI is about to develop a platform technology based on nanofibers that can be used as an effective yet low-cost filter barrier for making high performance facemasks, medical filters, etc.

Detection
It is critical to have a fast diagnosis of acute condition so that healthcare providers can prescribe the necessary treatments. NAMI continues to put in efforts to develop Lab-On-Chips for Point-of-Care applications. Currently NAMI focuses on applications in infectious diseases and clinically relevant biomarkers. These core technologies, which were built in house, will have a great impact across a platform of public healthcare sectors.

Nano medication
Nanotechnology revolutionises the way medicines are delivered. It enhances the drug bioavailability and leads to the use of less expensive drugs. NAMI currently works on topical delivery such as high performance skincare products but also has the vision that the proprietary technical knowhow in nanomaterials developed in house can be applied to other delivery products such as high-value generic pharmaceuticals. These nanomised delivery

systems and processes are expected to be applicable for use in nanomising Traditional Chinese medicines, Western medicines, herbal materials and other biologics.

2. Commercialisation and Technology Transfer to the Industry

Resulting from strategic commercialisation planning, there are a total of eight successful licences during financial year 2014-15. Commercialisation effort will be continuously enhanced through a more systematic approach to drive more success cases of commercialisation of NAMI's project results.

Enhance development of platform technologies to support local industries and achieve applied research excellence. Examples of platform technologies are highlighted as below –

i. Nano fibre technology
The technology has been adopted by an industry sponsor to develop a facemask that offers the protection of N95 respirator with the comfort of surgical mask. This technology is further used to develop a new PM2.5 safe facemask and wound dressing materials by industries. The nano fibre technology is also extended to develop separator for flexible lithium ion batteries that are intended for the rapid growing wearable consumer electronic markets.

ii. Printed electronics
Wearable electronics is a rapid growing technology area that can be viable opportunities to local industries due to its more flexible capital investment and scalable nature. NAMI has developed platform technologies in different ink formulation and solution based processing that have been adopted as background technologies for industries to develop applications in disposable temperature and gas sensors.

iii. Die Attach Adhesive
This award winning technology was originally developed and licensed to industries to deliver four times better heat dissipation of Light Emitting Diode light for longer product life. It is then adopted by an industry partner as background technology to solve heat dissipating challenge of high voltage plasma lighting. Other applications to improve thermal management of semi-conductor encapsulation are under consideration by industries.

iv. Light weight foam concrete
Another award winning technology from NAMI provides an innovative light weight cementitious materials to give benefits in energy and total cost savings as well as improved efficiency as compared to conventional concrete. Currently, the technology has been used to develop cementitious sound barrier materials. The technology can be scaled to other applications, such as internal partition to reduce overall loading requirements and more efficient thermal control.

v. Built-in bacteria repellent plastic materials
Infectious diseases are becoming a serious community concern. The demand for products with anti-bacteria property is increasing. NAMI is developing a new generation built-in anti-bacteria plastic materials that can stop growth of bacteria without the negative effects of conventional technology of using biocide. This platform technology can be applied in plastic and other materials for development into consumer, bio-medical and other industrial products.

3. Application of R&D Outcomes in the Public Sector and Benefits to the Community

Though the application of PSTS is allowed only after the completion of the approved project, NAMI will advance the development of PSTS opportunities together with target trial sites, supporting organisations and relevant industries in the early stage of the project. NAMI's aim is to maximise the benefits of its research outputs for our local community.

NAMI will continue to leverage the PSTS to increase the success of commercialisation of project results. This approach will cover its five market sectors, with technologies applicable to various aspects of markets including but not limited to consumer, industrial and healthcare products. Besides, NAMI will also complement government initiative in supporting the development of growing industrial segments, such as waste recycling, green technologies, etc. More proactive engagement with industries and relevant public sector bodies will be initiated to align technology needs to business opportunities that can drive and support the development of new industrial segments and technology advantages for Hong Kong's economic growth.

4. Promotion Activities and Liaison with Stakeholders, Including Local and International Collaboration

To promote NAMI's strong applied research results and commercialisation achievement, as well as its unique position as a materials expert in Hong Kong, and to open up more collaboration opportunities with the local enterprises, local and overseas research institutes, trade associations, etc., more extensive promotion activities and new initiatives will be undertaken apart from the existing annual programmes. These will include joint promotion activities with trade associations and key industry players, new product brochures, product launches and promotion activities, trade shows in Mainland and overseas, etc.

5. Budget and cashflow

Operating Expenditure (in $ million)

	5-year Cumulative 2006-07 to 2010-11	4-year Cumulative 2011-12 to 2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total
	(Actual)	(Actual)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	
Staff [(1)]	55.5	117.2	35.4	36.4	40.8	44.3	49.3	53.3	432.2
Accommodation [(2)]	8.1	18.0	7.3	9.0	10.0	12.3	13.2	13.5	91.4
Equipment and other capital cost[(3)]	9.8	24.6	5.4	6.8	9.1	11.0	10.6	9.6	86.9
Commercialisation[(4)] (including publicity, marketing, etc.)	0.8	4.9	1.7	1.9	2.0	2.2	2.4	2.5	18.4
Others[(5)]	11.1	31.4	11.0	13.0	14.3	16.6	17.9	18.9	134.2
Total expenditure:	85.3	196.1	60.8	67.1	76.2	86.4	93.4	97.8	763.1
Less: Admin. Overheads	0.8	12.9	3.6	6.8	10.0	12.0	13.0	14.0	73.1
Total operating cost from ITF :	**84.5**	**183.2**	**57.2**	**60.3**	**66.2**	**74.4**	**80.4**	**83.8**	**690.0**

Explanatory Notes –

(1) Staff cost covers basic salary, Mandatory Provident Fund contributions, medical insurance and is budgeted to include inflation and salary adjustment. The staff establishment of NAMI is forecast to reach 59 posts by 2020-21.

(2) The increase in expenditure for accommodation from 2017-18 is mainly due to the acquisition of additional laboratory and office space to cater for the expansion of NAMI.

(3) Increase in the equipment and other capital cost from 2017-18 to 2019-20 is due to the renovation of new laboratory and office space.

(4) Commercialisation budget increases over the years to meet the growth in the number of projects.

(5) Other miscellaneous cost items include IP management, property management fee, utilities expenses and various administrative expenses.

R&D Projects and Expenditure (in $ million)

	5-year Cumulative 2006-07 to 2010-11	4-year Cumulative 2011-12 to 2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total
	(Actual)	(Actual)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	(Estimate)	
No. of new projects commenced	45	94	52	54	59	62	65	68	499
No. of projects under commercialisation(1)	12	19	12	15	18	22	26	30	n/a
R&D expenditure ($ million) (2)	89.5	185.8	85	120	130	140	150	160	1,060.3

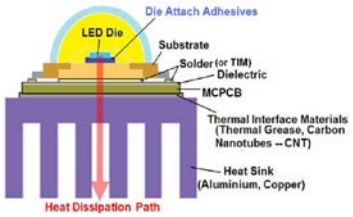
Explanatory Notes –

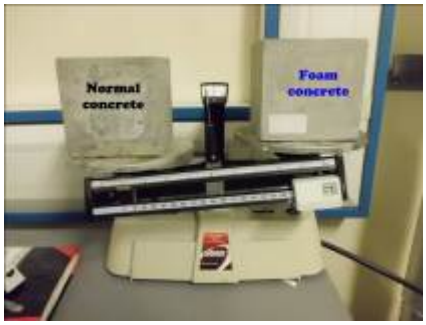
(1) The estimates are based on projects with guarantee payment from royalties and potential licensing deals.

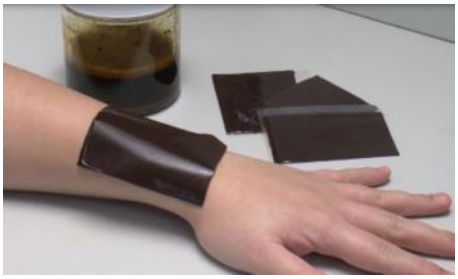
(2) The estimates are based on past expenditure trends and the increase in the number of new projects.

PART 5 – PROGRESS OF SELECTED PROJECTS ON R&D, COMMERCIALISATION AND USE OF R&D OUTCOMES IN THE PUBLIC SECTOR IN 2014-15

Project / Technology	Status / Progress
Bacteria-killing and Viruses-trapping Protective Masks  *The prototype of NAMI's facemask offering N95 protection but surgical mask comfort*	NAMI has developed a nonwoven mesh of nanofibers as filtration layer providing unique benefits such as respiratory comfort, antimicrobial protection and excellent filtration. The nanofiber technology has been adopted in applications such as filtering membranes used in medical devices and wound dressings. The technology has been adopted by an industry sponsor to develop a facemask that offers the protection of N95 respirator with the comfort of surgical mask. This technology is further used to develop a new Particulate Matter 2.5 safe facemask by the same sponsor. Moreover, another industry sponsor has adopted the technology to develop wound dressing materials. Other than bio-healthcare product, the nanofiber technology is also extended to develop separator for flexible lithium ion batteries that aims for rapid growing wearable consumer electronic markets by an industry sponsor.

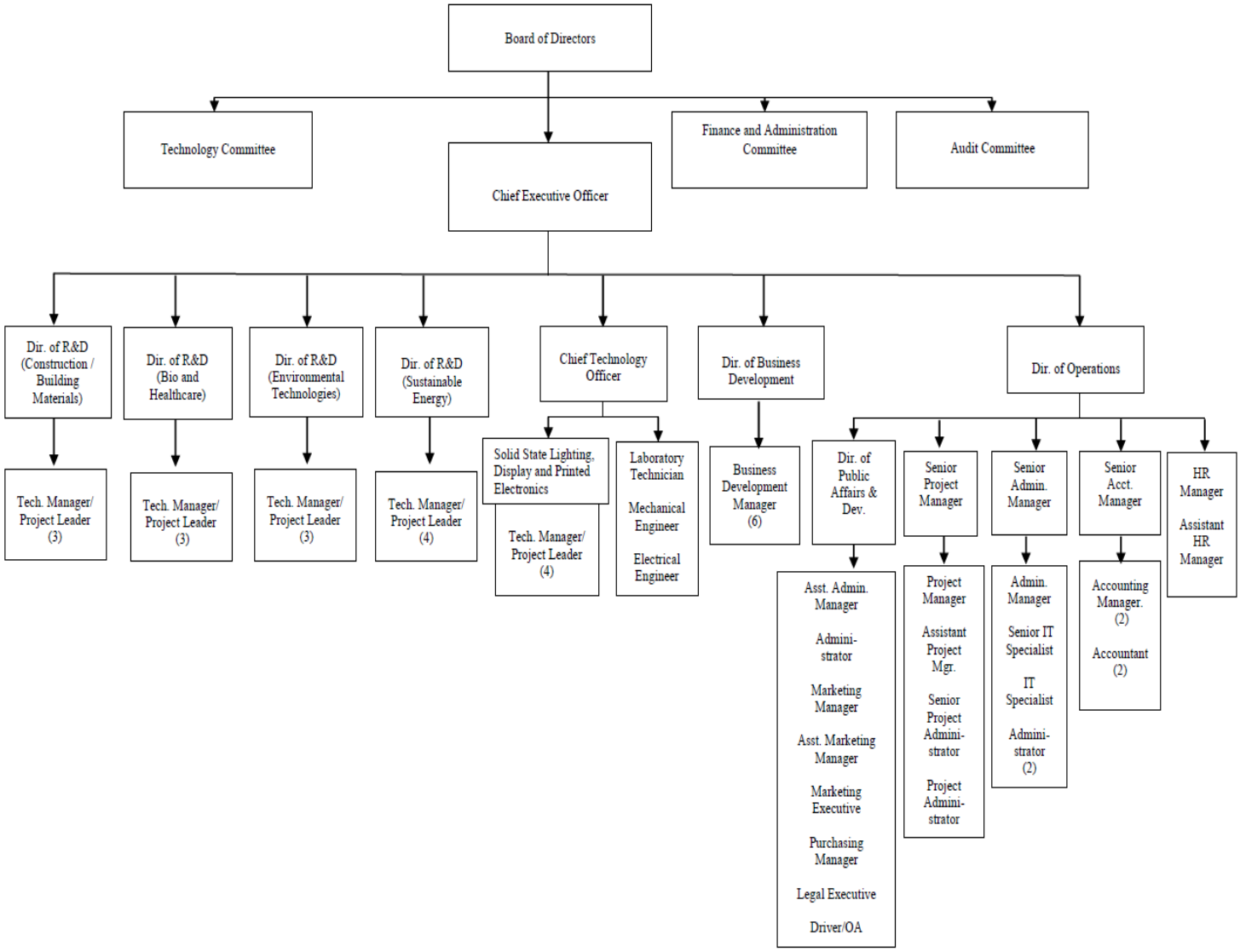
Project / Technology	Status / Progress
Development of Advanced Die Attach Adhesives with Nano-fillers/ Microcapsules for High Brightness LED  *Nano die attach adhesives*  *Structure of LED*	The technology aims at developing Die Attach Adhesive (DAA) material with high thermal conductivity which would help to enhance the service life of high brightness Light Emitting Diode (LED). The project has successfully completed in 2011. It has been received the Technological Achievement Award in the 2014 Hong Kong Awards for Industries. The technology has been licensed to a sponsor in the electronics industry. The licensee received positive customer response and they are now undergoing scale up production and processing trial orders. Besides, the technology has also been applied on thermal management of plasma lighting. The technology has been licensed to a Hong Kong-listed company, which uses it as background intellectual property for developing plasma lighting. The project has been approved and commenced in May 2014. NAMI is further expanding the technology application in other industries such as semi-conductor packaging. Further commercialisation of this technology is expected.

Project / Technology	Status / Progress
High Performance Cementitious Materials for the Construction of External Wall with Enhanced Thermal Insulation  *Compare the weight of foam concrete*  *Foam concrete fabricated in large-area panel*	NAMI has developed a light weight cementitious material with good strength, thermal conductivity and sound insulation properties. The development will greatly contribute to sustainable built environment. It has been awarded a certificate of Merit in the Hong Kong Awards for Environmental Excellence 2014. The technology leads to a collaborative project. An industrial sponsor has licensed the technology and used it as background intellectual property for development of a light-weight hydrophobic cementitious sound barrier. Besides, a PSTS project has commenced in May 2014. The prototypes will be in form of two demonstration rooms, one using the foamed concrete, and the other using normal concrete. Difference in energy consumption between the two rooms will be monitored. The project is supported by the Hong Kong Housing Authority (HKHA). With more energy consumption saving data from the PSTS, NAMI will be able to continue promoting the technology to potential licencees. In order to realise the application of NAMI's foamed concrete on buildings, NAMI is currently discussing a demo project with HKHA. The project will install NAMI's foamed concrete in designated public housing. With the substantial support from HKHA, it could encourage adoption of this new technology by construction industry.

Project / Technology	Status / Progress
A Nano Preparation for the Topical Treatment of Limb Injuries  *Nano-patch for the topical treatment of limb injuries*	NAMI has successfully developed a nano-patch for the topical treatment of limb injuries. Quality assurance has been introduced to monitor the patch production process. Pilot clinical trial has been applied to patients in PolyU Sports Rehabilitation Center with soft-tissue or bone injuries. Efficacy data and users' comments will be collected to support the product development process and to optimise the product specifications. It helps to facilitate the realisation of the R&D results by scale-up of patch production process and clinical trial. Besides, this technology was successfully licensed as background intellectual property for a collaborative project. The sponsor adopted the background technology for development of transdermal patch to enhance skin penetration for painkilling application.

Appendix

Organisation Chart of NAMI



Annex F

Contribution of the R&D Centres in Helping Persons in Needs

Introduction

The R&D Centres are part of the community. Apart from developing technologies to cater to the needs of the commercial sector, the R&D Centres have also developed technologies to cater to the needs of the public sector and persons in need. Elderly care service is an example of how technology can be utilised to make improvement to existing service and provide alternative solutions to different problems.

Utilising the Innovation and Technology Fund

2. The R&D Centres have been making good use of the Innovation and Technology Fund (ITF) in developing technology solutions and realising their use in the elderly care service sector. The Public Sector Trial Scheme (PSTS) under the ITF has provided funding to the R&D Centres to try different technologies that might benefit the elderly population in some welfare service providers. It provides additional funding up to the full cost of the original ITF-funded R&D projects for the production of tools/prototypes/samples and the conducting of trials in the public sector.

3. In a nutshell, R&D Centres can make use of the funding available under ITF to fund a project from R&D to its actual trials in the public sector, which includes Government departments, public bodies, non-profit making trade associations, etc.

Efforts of the R&D Centres in bringing the benefits of R&D projects to the elderly

4. As a result of the interactions and engagement with stakeholders, and with the support from the ITF, the R&D Centres have initiated various projects that bring hope and improvement to the delivery of elderly services. Suitable integration and adaptation of technologies such as mobile devices, cloud computing, nano-materials, and radio-frequency identification (RFID) have been tried in different service settings. Products includes, for example,

intelligent blind guiding stick, wearable electronics using radio frequency identification (RFID) to monitor the elderly who are susceptible to losing their ways, drug labelling readers, and community elderly information system. Key benefits identified from the application of technologies are relevant to the safety, convenience, quality of life and health of the elderly, and they are set out at Appendix A. Details of the products developed by the R&D Centres that have demonstrated potentials to provide benefits to the elderly are illustrated at Appendix B. A video featuring the applications of these innovative technologies is available at the following link –

https://youtu.be/qY22MxWfU9s

Reaching out and promoting to potential technology users

5. Various technologies have culminated in the establishment of "iHome" – a project to integrate the technologies for the enhancement of the quality of life of the elderly. With assistance from the Hong Kong Housing Society, a show flat has been set up to welcome visitors to experience and learn about the latest technologies for ageing at home. Health monitoring and safety technologies including tele-health system, wireless pulse oximeter, mobile and wearable sensors, and environmental control technologies, and etc., are put together in one location which demonstrates how technological advancements can make everyday life safer and healthier for the ageing population. This project received an award at the Ageing Asia Investment Forum in 2013.

6. To support the goal of an "age-friendly city", two R&D Centres have joined hands in turning Chung Ming Sheh, comprising a few storeys of a building of Clague Garden in Tsuen Wan, into an age-friendly elderly housing estate with technologies. Representatives from the World Health Organization (WHO) visited there in October 2014 and their feedback was very positive.

7. An R&D Centre organised "Technologies and Healthy Ageing Symposium" in September 2014 with about 400 participants to share and discuss how technologies could provide better support to the elderly and other issues relating to an ageing population.

8. Together with the ITC, the R&D Centres are in dialogues with different welfare organisations (such as Tung Wah Group of Hospitals) to explore further possibility of trying the technologies developed or to embark on new R&D projects to address problems related to serving persons in needs. There will be challenges ahead as the use of technologies involves long term commitment on the part of the service providers as well as cultural and mentality change in some cases. The Government hopes that all stakeholders can join hands in future to further utilise technology in the delivery of elderly services and facilitate independent living of our senior citizens. Meanwhile, the ITC will continue to encourage the trials of different technologies through the PSTS with a view to promote their commercialisation and realisation. R&D Centres would also continue to launch projects that can address the needs of the society.

Innovation and Technology Commission
June 2015

Benefits of Deploying Technology in the Delivery of Elderly Care Services

Key benefits identified from the application of technologies are relevant to the safety, convenience, quality of life and health of the elderly. They are set out below–

(a) Enabling independent living and ageing in place with respect

This is in line with Government's policy to encourage ageing in place. With technologies that can serve as eyes, ears and voices of the elderly, or technologies that enable a comfortable ambience, the elderly will be able to live in their homes instead of institutions that many of them do not prefer to stay.

(b) Reducing demand for elderly care service workers and professionals

While new elderly care homes and hospitals could be built, we may not have enough professionals to provide the services in future given the projected demographic profile. Tele-health equipment, for example, combined with other smart devices can reduce the need to visit clinics personally. Caretakers can also remotely monitor clients who are staying in their own homes.

(c) Enhancing comfort level of the elderly

The RFID and Global Positioning System (GPS) tracking devices, for example, will give the elderly more freedom to go out and socialise with friends or join outdoor activities. Remote environmental control at home will enhance the comfort level for bedridden persons.

(d) Alleviating stress on family, friends and caretakers

Family and friends, for example, can monitor the conditions of the

elderly from a distance, and even round the clock and hence relieve them of the fear of leaving their loved ones alone. With advances in technology, privacy of the elderly can be protected despite their health being remotely monitored. For social workers and nurses, the use of tracking systems to identify the whereabouts of a person under their care would significantly alleviate their workload.

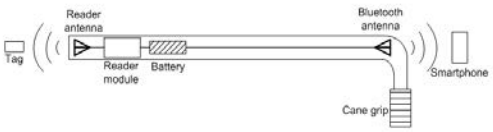
(e) Creating room for possible cost and improve productivity

A caretaker may save time and effort of physically checking the elderly from time to time with the use of suitable new sensing or tracking technologies. The manpower and time can be used in other more meaningful work, such as planning activities or to provide services to more people.

2. The above benefits, however, are difficult to quantify. Like other advances in technologies such as the use of internet and smart phones, the productivity gained is widely recognised but it would be difficult to measure it in terms of monetary benefits. Another driver for adoption of new technologies is that the initial installation cost has been dropping over the years. Take RFID as an example, a handheld reader could now be acquired for a few hundred dollars and the tags are now costing a few dollars each, which is only a fraction of what they were a few years ago.

Highlights of Key Technologies

1. Smart Guiding Cane for visually impaired (with mobile apps)



Technology	Usage	Benefits
Using RFID readers and tags Near field communication (NFC)	➢ Visually impaired people can be guided by the device to move around, and hear their whereabouts. ➢ Can also be used to read tags on objects and assist the users in identifying them.	➢ Promote safety and quality of life ➢ Easier for visually impaired to navigate

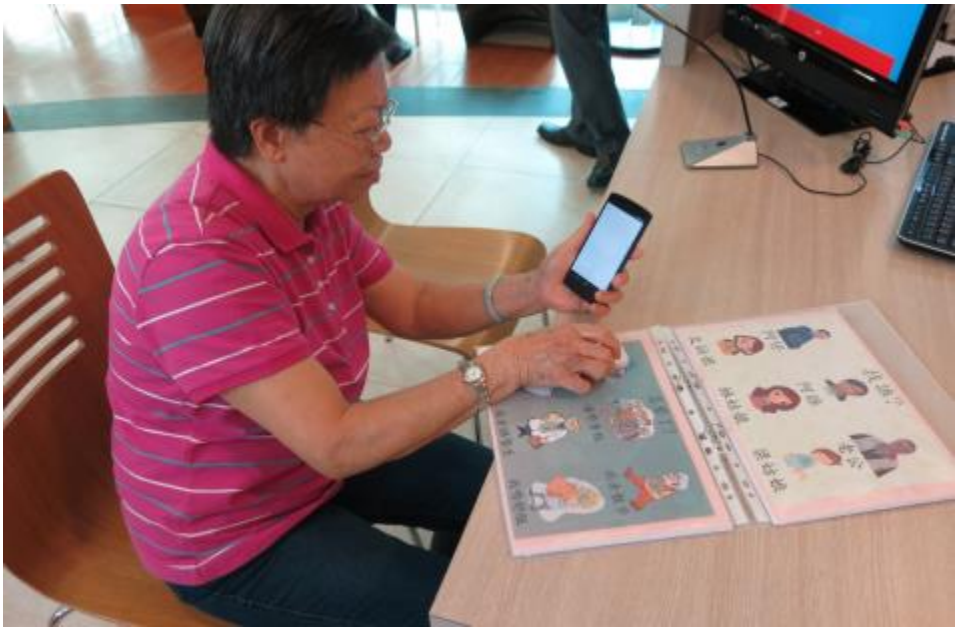
2. RFID system to enhance in/out gate monitoring

Technology	Usage	Benefits
Specific RFID Tag	➢ Provide an apparel-based tracking system	➢ Enhance monitoring capability to the elderly who are susceptible to losing their way

3. Low-cost and multi-purpose personal RFID reader(with mobile apps)

Technology	Usage	Benefits
Lightweight RFID Reader Chip	➢ Used to read tags on objects and assist the Elderly to know the drug information clearly.	➢ Avoid overdose of drugs

4. Personal RFID phone book and communication tools



Technology	Usage	Benefits
Low cost reader with Bluetooth connectivity Mobile Apps and Internet of Things (IoT) platform for elderly via Wi-Fi connection	➢ Elderly can use a phone book to perform digital device operations	➢ To help elderly easily dial to others or sending short message.

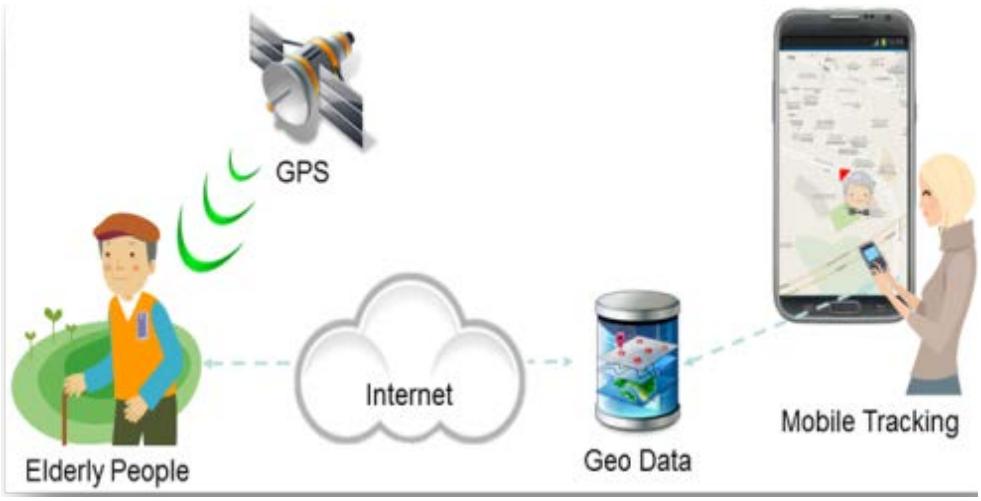
5. Smart objects for elderly (posters, drug bag/bottles, etc.)

Technology	Usage	Benefits
Low cost reader with Bluetooth connectivity Mobile Apps and IoT platform for elderly via Wi-Fi connection	➢ Objects like posters or photos will be tagged to enable the elderly to hear the information of the objects	➢ Audible information can be provided to elderly by touching the reader on the RFID tagged objects

6. Mesh and versatile Wi-Fi Infrastructure

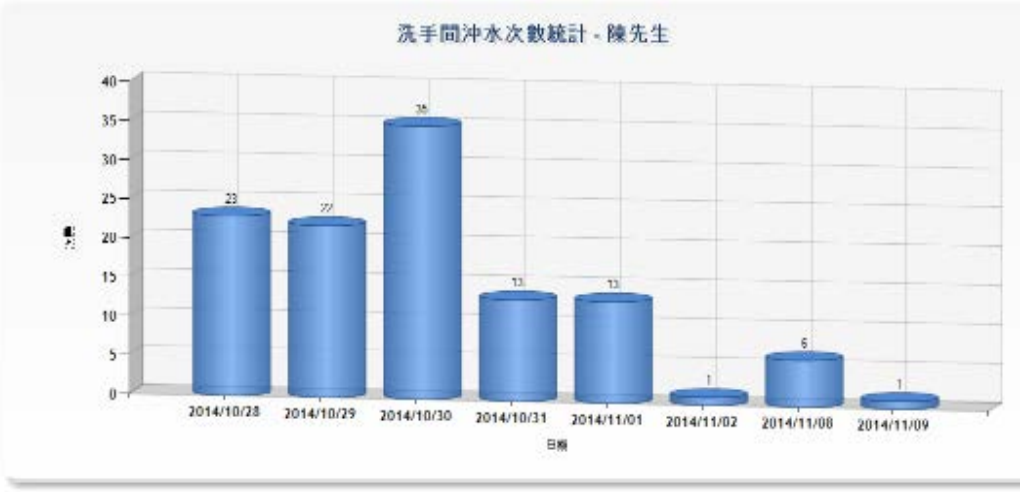
Technology	Usage	Benefits
Mesh Wi-Fi infrastructure for wireless communication	➢ Wi-Fi Mesh network serves as the network infrastructure to support various service options	➢ Improve the elderly daily activity. For example, personal RFID equipment for elderly to obtain information of the organised activities & home PA system for estate-to-resident announcement.

7. GPS tracker and tracking platform for outing functions



Technology	Usage	Benefits
GPS tracking device RFID-based Interoperable Gateway (RIG) technologies	➢ Provide an apparel-based tracking system ➢ Devices and mobile phone validation	➢ Better monitoring of elders during outings ➢ Enhance outdoor elderly caring service for organizations

8. Home-stay wellness sensor and alert function (“flushing sensor”)



Technology	Usage	Benefits
Mesh Wi-Fi infrastructure for wireless communication	➢ Sensors will be installed and setup in the flushing tanks	➢ Information collected can be used for various caring and medical treatment purposes

9. Community Elderly Healthcare System

- Health data collection
- Operations by professional personnel
- Health data storage for analysis to reduce the frequency to visit doctors
- Enhancement of the capability of community support and health services

Technology	Usage	Benefits
Wireless vital sign measurement device interfaces for health data collection such as weight, blood pressure and heart beat rate.	➢ Provide a software system solution to facilitate health data collection, instant feedback on the collected health data, and health data report generation for further doctor consultation	➢ Enhance community services through routine monitoring of the health of residential elderly

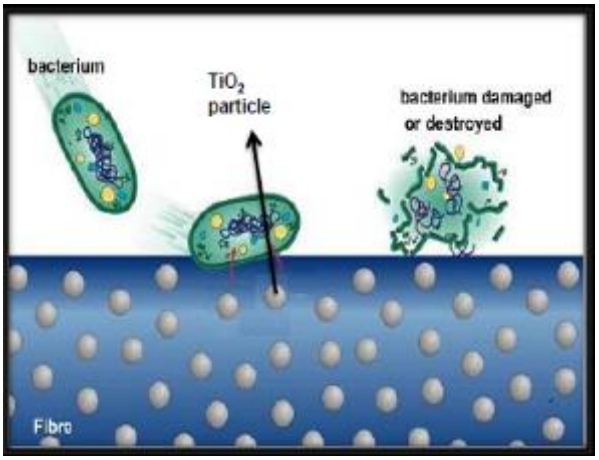
10. Elderly e-Information Platform

Technology	Usage	Benefits
e-Reading of contents tailored for elderly Elderly-friendly interface	➢ An information platform realized on a tablet, providing reading materials related to elderly living, community news, government alerts, etc.	➢ A more efficient way of information dissemination for elderly, taking advantage of electronic devices of this day and age.

11. Adult Bibs for Elderly Care Home


Technology	Usage	Benefits
Using state-of-arts weaving and finishing technologies	➢ Replace the traditional bibs for the elders in local elderly centres to prevent hygiene problems, e.g. water proof during their meals	➢ Improve the quality of hygiene issues in elderly centres ➢ High durability for several cycle of high- temperature washings (e.g. 90˚C)

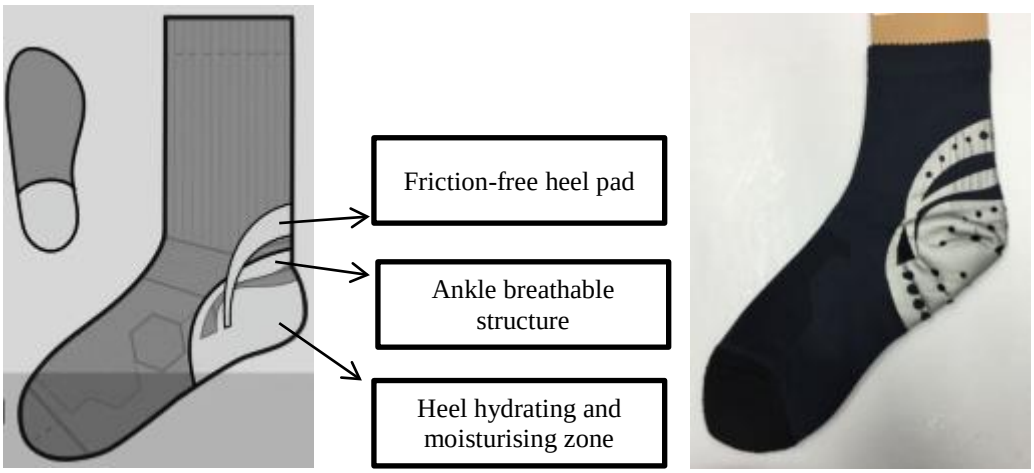
12. Room Light Induced Antibacterial Textile



Titanium Dioxide (TiO2), as a catalyst, absorbs room light to decompose organic compounds into water and carbon dioxide.

Technology	Usage	Benefits
Novel visible light photocatalytic bactericide – Titanium Dioxide (TiO_2)	➢ Providing a sustainable and efficient antibacterial environment in elderly centres ➢ Bacterial infection will happen by using traditional curtain ➢ This curtain can achieve the antibacterial function under the normal room light radiation	➢ Enhance the living environment of the elderly ➢ Easily to adopt in elderly centres by only replacing the old curtains

13. Biofunctional Materials



Technology	Usage	Benefits
Antibacterial, skin moisturising functions and comfortable touch	➢ Provide the moisture for the dry skin of the elderly persons, prevent bacterial illness on their feet. ➢ It can help addressing the problem of poor low limb circulation, dry skin, weak sensory responses to low limb.	➢ Enhance the skin moisture of elders. ➢ Reduce the reliability of using medical cream