Innovation and Technology Support Programme

Application Form

(Mid-stream, theme-based)

General

1. Please read the **'Guide to Filling in the Application Form for the Innovation and Technology Support Programme (ITSP) (Mid-stream, theme-based)' ("Guide")** before completing this form.

2. Applications should be submitted by the lead applicant (a university funded by the University Grants Committee (UGC)). Applications submitted by individuals will not be accepted.

3. In case of an application involving more than one party (e.g. collaboration of researchers across multiple disciplines or research institutes), the lead applicant should fill in the form.

4. If an applicant wishes to apply for more than one project, it should complete one form in respect of each project.

5. Please complete this form in either Chinese or English (with the exception of certain sections for the purpose of uploading to the Innovation and Technology Fund (ITF) webpage in future as necessary).

6. Please attach annex(es) if space provided in the form is insufficient. Other information in support of the application, e.g. diagrams, photos, etc., is welcomed. Where necessary, the Innovation and Technology Commission (ITC) will require the lead applicant to produce the originals of the supporting documents for verification.

7. All information provided in the form will be used for processing the application and for related purposes, e.g. project monitoring, statistical analysis, etc. It may be disclosed to other bureaux/departments of the Government of the Hong Kong Special Administrative Region ("the Government") or third parties, if such disclosure is necessary.

8. Applications must be submitted to the ITF Secretariat electronically through the Innovation and Technology Commission Funding Administrative System (https://itcfas.itf.gov.hk/).

9. In the event of any inconsistency between this form and the Guide mentioned in paragraph 1 above on the one hand, and the agreement to be signed between the Government and the lead applicant in relation to the approved project on the other, the latter will prevail.

10. This form is divided into the following sections: -

Part A	The Applicant
Part B	The Project
Part C	Assessments
Part D	Attachments for the Application
Part E	Declaration

Project Title	(Chi) 用於節能建築的智能自適應控制及監控系統
	(Eng) Smart Adaptive Control and Monitoring System for Energy-efficient Buildings
Lead Applicant Note	(Chi) 香港研發大學
	(Eng) Hong Kong R&D University

Note:

1. The lead applicant must be a university funded by the UGC.

Part A The Applicant

I. Information on Lead Applicant

For applications involving more than one party, the lead applicant should fill in this form and provide all necessary information with the consent of parties concerned.

Lead Applicant

☑ **University funded by the UGC^**

- ❍ City University of Hong Kong (CityU)
- ❍ Hong Kong Baptist University (HKBU)
- ❍ Lingnan University (LU)
- ❍ The Chinese University of Hong Kong (CUHK)
- ❍ The Education University of Hong Kong (EdUHK)
- ❍ The Hong Kong Polytechnic University (PolyU)
- ❍ The Hong Kong University of Science and Technology (HKUST)
- ❍ The University of Hong Kong (HKU)
- ● Others, please specify
  Hong Kong R&D University

^ *Please refer to the website of UGC (www.ugc.edu.hk) for an up-to-date list of universities.*

Please select (by putting in '√') where appropriate.

Key Contact Person(s) Assigned by the Lead Applicant [Note]

1. Project Coordinator – on technical matters

Name	(Chi)	陳大文 教授
	(Eng)	Prof. Tai-man CHAN
Post Title		Chair Professor of Computer Science
Department/Unit		Department of Computer Science
Address	(Chi)	
	(Eng)	Rm 111, ABC Engineering Building, HK R&D University, Kowloon
Tel		+852-2111-1111 Fax +852-2222-2222
E-mail		tmchan@hkrdu.edu.hk

2. Administrative Coordinator – on administrative matters

Name	Mr. CHAN Siu-ming
Post Title	Director, Office of Knowledge Transfer and Research
Address	Rm 222, DEF Building, HK R&D University, Kowloon
Tel	+852-2333-3333 Fax +852-2444-4444
E-mail	smchan@hkrdu.edu.hk

Note: Please provide details of two key contact persons, one to be responsible for overseeing the carrying out of the R&D project (e.g. technical matters) and the other to be responsible for handling administrative matters. The lead applicant may choose to designate one person to be in charge of both.

II. Information on Research Partner(s)/Sponsor(s)/ Supporting Party(ies)

Research Partner(s) *(only applicable to collaboration projects involving multiple disciplines or research institutes. A research partner can be a different unit of the same university, or a different local/non-local university/research institute)* **Note**

Sponsor(s) *(only applicable to projects involving sponsorship)* **Note**

Supporting Party(ies) **Note**

		Name	Type^	Contact Person (Post Title, Department/Unit, Tel No, Fax No and E-mail)
In Hong Kong	Government departments/ public bodies (政)			
	Companies/ industry or trade associations (產)	ABC (HK) Ltd	2	Dr. Grace CHOW CEO 2555-5556 2666-6667 ceo@abc.com.hk
		XYZ Industries Ltd	2	Dr. Mary WONG CEO 2555-5557 2666-6668 ceo@xyz.com.hk

	Universities (學)	Hong Kong Scientific University	1	Prof. John LAM Professor, Department of Electronic Engineering 2888-8888 2999-9999 johnlam@hksu.edu.hk
	Other research institutes (研)			
	Others (e.g. charitable trusts or prominent personalities in the field)	HK ABC Association Jockey Club Charitable Trust	3 3	Dr. Siu-ming WONG Director 2555-5555 2666-6666 smwong@hkabc.org Ms. Jane TSE CFO 2555-5565 2666-6676 cfo@hkjc.org

		Name	Type^	Contact Person (Post Title, Department/Unit, Tel No, Fax No and E-mail)
Outside Hong Kong	Government departments/ public bodies (政)			
	Companies/ industry or trade associations (產)			
	Universities (學)			
	Other research institutes (研)			
	Others (e.g. charitable trusts or prominent personalities in the field)			

Note: Please provide supporting documents.

☑ Supporting/reference document(s) is/are attached.

☑ I/We confirm that the sponsor(s) is/are company(ies) and will be user(s) of the project deliverables (only applicable to projects with industry sponsorship).

^ *Please indicate the type by -*
1 - Research partner
2 - Sponsor
3 - Supporting party

Part B The Project

I. Key Project Details

1. Project Title : Smart Adaptive Control and Monitoring System for Energy-efficient Buildings

2. Type of Project^

☐ Standalone project (funding up to HK$5M)	☑ Collaboration project involving multiple disciplines or research institutes (funding up to HK$10M)

^ *Please select (by putting in '√') where appropriate.*

3. Total Project Cost (HK$'000): 4,355.375

Amount of Total Financial Contribution including Industry Sponsorship, if any (HK$'000) Note: 500.000

Amount of ITF Funding Sought (HK$'000): 3,855.375

4. Schedule of the Project Period

Commencement Date (dd/mm/yyyy): 01/ 04 / 2024

Completion Date (dd/mm/yyyy): 31/ 03 / 2026

Duration of the Project Period (no. of months, max. 36 months): 24

Note:

Industry sponsorship is not mandatory.

5. Related Information

(a) Whether previous research has been done in relation to the proposed R&D work?

☑ Yes.

Please list previous projects and funding obtained e.g. ITF, UGC/Research Grants Council (RGC) (in particular the Areas of Excellence (AoE) Scheme, Theme-based Research Scheme (TRS) and Collaborative Research Fund (CRF)), Environment and Conservation Fund (ECF), etc.

Project Reference No.	Project Particulars	Funding Obtained
ITSP Seed Project (ITS/999/19)	Novel Adaptive Control Algorithm of HVAC for Energy-efficient Buildings	ITSP
RGC funded research (xxxxxxx)	Feasibility Study on Closed-loop Control System on HVAC by Deep Learning for Energy-efficient Buildings	RGC

Please see Annex 1 "Technical Background" for more information.

☐ No.

(b) Has there been/will there be any attempt to seek funding support for this project from sources other than the ITF?

☐ Yes. (Please provide details.)

☑ No.

II. Brief Description of Project Proposal

1. Research Theme ^

☑ Engineering technologies for environmental sustainability

Covers a wide range of technology areas in engineering discipline, including net-zero electricity generation, energy saving, green building, green transport and carbon audit.

☐ Biologics and cell-based therapies

Research and development of biologics (such as peptides, proteins or antibodies) and cell therapy technologies to modulate immune system for human disease treatment purposes, but exclude drug target identification and drug screening.

^ *Please select one of the above by putting in '√'.*

Please provide details how this project is relevant to the selected research theme above.

According to the Environment Bureau of Hong Kong government in 2015, about 54% of Hong Kong total annual energy use is in the form of electricity consumption, and buildings account for about 90 % of the city's electricity usage. Therefore, promoting the innovations and technologies to save building energy would be critical to energy saving.

The objective of this project is to develop an integrated smart control system of HVAC (Heating, Ventilation and Air Conditioning) for energy efficient buildings. Together with the information collected by the environmental sensors, HVAC would be adaptively controlled to meet thermal comfort requirement with reduced carbon emission. The proposed solution would create sustainable energy efficient buildings.

Key technology areas in this project include artificial intelligence-based data analytics, power efficient environmental sensor design, and advanced computational modelling techniques for design would be developed. The project is relevant to the research theme of ITSP (Mid-stream, theme-based).

2. Project Summary (no more than 200 words)

(Please provide a summary of the project objectives, R&D methodology involved, impact and benefits, etc.)

(Chi)

本項目將開發用於可持續節能建築的新一代智能控制及管理監控系統的技術。研發的技術將有效增加建築的能源使用效率及減低二氧化碳排放量，並能達到合適的熱舒適度。本項目涉及一系列的技術，包括具有低成本環境傳感器，暖通空調智能自適應節能控制系統及基於人工智能技術的數據分析技術。

這研究可以用作可節能建築的技術開發平台，支持香港政府 2015 年倡議的 2015 - 2025+節能計劃。

(Ref: https://www.enb.gov.hk/sites/default/files/pdf/EnergySavingPlanTc.pdf)

(Eng)

This project would develop an integrated smart control and monitoring system technology to improve the energy efficiency and reduce the carbon footprint of a building. A series of technologies, including low cost environmental sensors, smart adaptive energy efficient control for HVAC (Heating, Ventilation and Air Conditioning) and artificial intelligence-based data analytics would be involved in this project.

The proposed technological solution in this project would bridge the gap between the fundamental studies and the practical engineering, by the novel but technically feasible and cost-effective technology solutions, in order to contribute to the technological upgrading of industries.

This research can serve as a platform for further developing science and technology in this important area and support the development of Hong Kong government's 2015 - 2025+ Energy Saving Plan.

(Ref: https://www.enb.gov.hk/sites/default/files/pdf/EnergySavingPlanEn.pdf)

3. **Project Deliverables** (no more than 300 words)

(Please provide a brief description of the R&D output in both qualitative and quantitative terms and the timeframe required for achieving it.)

1. Design, fabrication and evaluation of different environmental sensors (i.e., pressure sensor, humidity sensor, flow sensor and temperature sensor) with wireless connectivity
2. Design of PID control for HVAC
3. Development of open-loop building model for adaptive control system
4. Deployment of sensors to monitor the demo room
5. Development of closed-loop building model for smart control system
6. Deployment and evaluation of the smart control system with sensors for HVAC in the demonstration room

Please see Annex 2 "Specifications of the deliverables" for more information.

4. Wider Total Effect

Please provide details on whether this project is related to other projects (ITF or non-ITF; previous or on-going) to create synergy and a wider total effect, e.g. three different projects to combat water pollution at a certain location.

There was a completed Seed project (12 Aug 2020 - 11 Aug 2021) about the adaptive control algorithm of HVAC for energy-efficient buildings. These projects can create synergy in providing the framework of the smart control algorithm of HVAC, with the data collected from those environmental sensors, for satisfactory thermal comfort in indoor area with reduced carbon emission.

5. Location of R&D work

Please provide details on the geographical location(s) where the R&D work will be undertaken: local vs. outside Hong Kong with the name(s) and place(s) of the research institute(s).

Location	Name/Place of each Research Institute	Percentage of R&D work to be Undertaken Note	Percentage of R&D Expenditure (i.e. net of overheads) to be Spent Note
Local	Hong Kong R&D University Hong Kong Scientific University	80% 20%	80% 20%
Outside Hong Kong			

Note: The majority of the R&D work of the project should be conducted within the territory of Hong Kong. However, up to 50% of the R&D work of a project can be conducted (and relevant expenditure incurred) in the Mainland. Where certain R&D tasks need to be conducted outside Hong Kong (other than the Mainland), prior approval from ITC must be sought with justifications.

6. Project Milestones

Please set out the key milestones at different stages of implementation (including R&D work conducted by each research partner(s), if any).

Proposed Commencement Date: 01/ 04 / 2024

	Calendar Date (dd/mm/yy)	**Work Progress** **(in quantity and quality where possible, with start/end date of each item; excluding administrative activities such as staff recruitment and equipment procurement)**
1st Project Milestone: (12th month from commencement)	31/03/25	Deliverable 1: Design of different environmental sensors (i.e., pressure sensor, humidity sensor, flow sensor and temperature sensor) with wireless connectivity [01/04/2024 to 31/08/2024] Fabrication of different environmental sensors [01/09/2024 to 31/31/2024] Evaluation of different environmental sensors [01/01/2025 to 31/03/2025] Deliverable 2: Design of PID control for HVAC [01/04/2024 to 31/08/2024] Deliverable 3: Development of open-loop building model for adaptive control system [01/09/2024 to 31/03/2025]

2nd Project Milestone: (24th month from commencement)	31/03/25	Deliverable 4: Deployment of sensors to monitor the demo room [01/04/2025 to 30/09/2025] Deliverable 5: Development of closed-loop building model for smart control system [01/10/2025 to 31/03/2026] Deliverable 6: Deployment and evaluation of the smart control system with sensors in the demonstration room [01/10/2025 to 31/03/2026] Please see Annex 4 "Project Implementation Plan" for more information.
3rd Project Milestone: (36th month from commencement)		

Proposed Completion Date:	31/03/26

Part C Assessments

I. Innovation and Technology Component

Please refer to the assessment framework in Part C of the Guide.

1. Please provide details on how the project pertains to applied research (e.g. expected project outcomes and impacts, merits of the proposed collaborative efforts (for collaboration projects only), background leading to the project, rationale and innovation of the proposed R&D, comparative analysis and supporting data, etc.). If there are supporting documents, such as background information, preliminary results, diagrams and figures with detailed legends etc., they can be included as annexes to be submitted with this application form.

The extreme global climate change has currently become a very critical issue which is resulted by the global increased emission of carbon dioxide. As electricity consumption of buildings is one of the major contribution of carbon emission in urban areas, it is of paramount importance to develop new energy efficient building technology with low carbon footprint for sustainable development.

Many studies reported that energy consumption of HVAC is the primary energy consumption of buildings, it is highly desirable to implement adaptive control architectures to reduce the energy consumption of HVAC systems without scarifying the user thermal comfort.

Current HVAC control methodologies typically consists of intuitive on/off controllers which take no consideration on high thermal inertia of many HVAC processes, or use simple PID controllers which are not satisfactory to have a converged solution in such complex closed-loop optimization process. On the other hand, the control methods rely on the deployment of many environmental sensors, thus the power consumption of the sensors would be very sensitive to the energy consumption of the overall control system.

Based on the algorithms from a previous funded RGC research, "Feasibility Study on Closed-loop Control System on HVAC by Deep Learning for Energy-efficient Buildings", the team will further investigate the smart control algorithm for energy saving of HVAC, when fulfilling the user thermal comfort inside the building. With the use of data collected from the environmental sensors located in different indoor locations, HVAC would be optimized to offer comfortable wind flow with acceptable temperature. The environmental sensors would be re-designed so that the overall power consumption would be

significantly reduced. Based on preliminary calculation, the overall monitoring system with 20% energy reduction of HVAC would be expected.

Please see Annex 1 "Technical Background", Annex 2 "Specifications of the deliverables" and Annex 4 "Project Implementation Plan" for more information.

2. Please provide details from the following angles as fit:

Area	Details
(a) Whether the project will give rise to new technologies or products (global/regional/ Hong Kong)	This project will develop new technologies, including smart adaptive control system for energy efficient building, low-cost power efficient environmental sensors, new data analytics program for customized HVAC control to achieve optimal thermal comfort level for local buildings.
(b) Whether the project will enhance quality (e.g. capacity, reliability, speed, etc.)	The smart control and monitoring system can reduce energy consumption of a building. Particularly, the energy consumption of the environmental sensors will be reduced by about 90% due to advanced circuit design technique and customized operation cycle. The HVAC, with the use of the smart control and monitoring system, will save the nominal power consumption by 20%.
(c) Whether the project will render production or application cost more competitive	Part of the project would be the sensor development by using a commercial 12-inch CMOS foundry. The production cost would become more competitive by the benefit of reduced fabrication cost of CMOS foundry.
(d) Whether the project will lead to further downstream R&D work	The project deliverables would enable a platform for further research and development of smart adaptive / monitoring system, with potential IoT sensors and actuator. The platform would facilitate the development of new household monitoring / smart control applications.

(e) Others	N/A

II. Technical Capability

1. R&D plan and methodology:

   A maximum of five A4 pages in total for the following items shall be provided including:

   a) detailed R&D plan and methodology and the responsible party(ies) for each project milestone set out in Part B.II.6 to justify the viability of the proposal from the technical perspective; and

   b) the technical specifications and targeted results.

The project is divided into two phases.

Phase 1: Sub-system / module design in the first year of the project [01/04/2024– 31/03/2025]:

1. Design, fabrication and evaluation of environmental sensors with wireless connectivity [01/04/2024 – 31/03/2025]

   The team by the Research Partner, Prof. John LAM will design, fabricate and evaluate various environmental sensors (i.e., pressure sensor, humidity sensor, flow sensor and temperature sensor) for this project. The overall module design with wireless connectivity would be completed by 31/03/2025.

2. Design of PID control for HVAC [01/04/2024 – 31/08/2024]

   PID control for the control system of HVAC would be designed. The PID control would be compatible to the building model for adaptive control system.

3. Development of open-loop building model for adaptive control system [01/09/2024 – 31/03/2025]

   With the use of the environmental sensors, PID control and HVAC, open-loop building model for adaptive control system would be designed. It would be the baseline of further optimization in the later stage of the project. All necessary user interfaces and application interfaces would be developed for adaptive control algorithm implementation.

Phase 2: Overall smart controlling/ monitoring system, demonstration trial and fine tuning in the second year of the project [01/04/2025 – 31/03/2026]:

4. Deployment of sensors to monitor the demo room [01/04/2025 to

30/09/2025]

Preliminary trial test of the environmental sensors would be conducted. Basic trial results would be collected, including the sensor reading at different sensor locations, feedback of user comfort with different activities, etc. The aim of this deployment is to create a database for development of closed-loop building model for smart control system of HVAC.

5. Development of closed-loop building model for smart control system [01/10/2025 to 31/03/2026]

   Based on the information collected in project deliverable #4, the infrastructure of the monitoring system would be constructed and closed-loop building model would be setup accordingly for the adaptive control of HVAC and maintaining acceptable user comfort level.

6. Deployment and evaluation of the smart control system with sensors in the demonstration room [01/10/2025 to 31/03/2026]

   A thorough demonstration trial of deploying the environmental sensors of two rooms (A classroom: 10m x 15m, a conference room: (30m x 15m). The trial would help to evaluate the energy saving performance of the control system, with different sensor deployment strategies. The control system with different user activities would be evaluated as well. Based on results from the trial, the project team will perform the fine-tuning and the respective follow-up actions if necessary.

Additional Information: Please see Annex 1 "Technical Background", Annex 2 "Specifications of the deliverables" and Annex 4 "Project Implementation Plan" for more information.

2. Background of the Project Coordinator and the research team:

Please provide details on the competence of the Project Coordinator and the research team by providing background, qualifications, experience, track record in previous research (especially ITF), recognition (locally and outside Hong Kong), etc. Please state the role of key members/involved parties in implementing the project. Please include any other information you consider useful to support the application (e.g. industry and academic awards won in the past, endorsement of outstanding experts in the field, etc.).

Project Coordinator	Prof. Tai-man CHAN (PhD in Computer Science, Harvard) has over 20 years of R&D experience in signal processing, information theory, and digital communication. (Please see CV in Annex 3) Prof. Chan will be the Project Coordinator to manage the project team and to liaise with external parties to conduct the demonstration trial.
Research Team	[Research Partner(s), if any] Prof. John LAM (PhD in Electronic Engineering, University of British Columbia) has over 15 years of R&D experience in sensor design by semiconductor technology. Prof. LAM is the project research partner from the Department of Electronic Engineering, Hong Kong Scientific University. He and his project team will provide support in the development and evaluation of various environmental sensors and support the demonstration trial. [Team members] Dr Peter LI, PhD in Electronic Engineering, Oxford University has over 10 years of R&D experience in software design, machine learning and optimization (Please see CV in Annex 3). Dr Li will be the Deputy Project Coordinator supervising the architecture design of the smart control system. Ms Siu-ling WONG, HKU (First Class Hon.), Stanford University (Research Scholar) has over 15 years of R&D experience in control theory, design and implementation. (Please see CV in Annex 3). Ms Wong will be responsible for the software

	design of the control interface between the smart control system and the HVAC, and support the demonstration trial.

III. Financial Considerations

A. Project Expenditure

Please list all the expenditure items to be incurred within the Project Period and provide breakdown of each item in the following sections.

Summary:

	Cost (HK$'000)
(i) Manpower	2,640.000
(ii) Equipment	60.000
(iii) Other Direct Costs	382.000
(iv) Research Partner's Expenditure	770.500
(v) Administrative Overheads	502.875
Total Project Cost (A):	**4,355.375** **(i)+(ii)+(iii)+(iv)+(v)**

(i) Manpower

Please provide details of members in the team in descending order (i.e. more senior members first).

Post title/ rank [Note]	No. required	Duration (months)	Monthly rate or equivalent (HK$'000)	Total (HK$'000)	Justifications (e.g. qualifications, duties, core R&D work performed for completing project milestones and producing project deliverables with clear articulation to project duration, etc.)
Senior research associate	1	24	40.000	960.000	Develop, simulate and evaluate the adaptive control system for HVAC. The appointee is not an existing staff of the University.
Research associate	1	24	30.000	720.000	Design, simulate and evaluate the environmental sensors. The appointee is not an existing staff of the University.
Research assistant	2	24	20.000	960.000	Develop, simulate and evaluate the building model for the adaptive control system for HVAC. The appointee is not an existing staff of the University.
			Sub-total A(i):	**2,640.000**	

☑ I/We confirm that the project team members listed in the table above are not existing staff of the lead applicant (and research partner(s) for collaboration projects). Any student(s) to be engaged for this project will not be double-funded by both the lead applicant (and research partner(s) for collaboration projects) and the ITF for carrying out the same set of responsibilities.

☑ I/We confirm that the manpower cost covers no other than the salary of project staff, including employer's mandatory contribution to the Mandatory Provident Fund (MPF), contract gratuities, annual salary adjustment (excluding increments and promotions)

and general fringe benefits (e.g. medical) in accordance with the established mechanism of the lead applicant.

Note: *Please indicate (by putting in *) for Deputy Project Coordinator (if applicable).*

Additional Information: Please see Annex 5 "Budget Justification" for more information

(ii) Equipment

Equipment to be used [Note]	Quantity	Unit cost (HK$'000)	Total (HK$'000)	Justifications (e.g. why essential for the research, reasons why existing equipment cannot be used/shared for the project; how equipment will be treated after completion of the project, etc.)
High end workstation	2	20.000	40.000	See Annex 5 "Budget Justification" The University does not have dedicated high end workstations for this project at this moment.
Oscilloscope	1	20.000	20.000	See Annex 5 "Budget Justification" The University does not have dedicated oscilloscope for this project at this moment.
	Sub-total A(ii):		**60.000**	

☑ I/We confirm that the equipment will remain under the ownership of the lead applicant for at least two additional years after the project completion or termination of the project agreement.

Note:

1. *Please indicate (by putting in [#]) where the equipment is estimated to cost HK$500,000 or above per item.*

2. *Please indicate (by putting in [@]) where the equipment is to be covered by in-kind contribution.*

3. *Only cost of new equipment for implementing the project can be charged to ITF.*

Additional Information:	Please see Annex 5 "Budget Justification" for more information

(iii) Other Direct Costs

Item [Note]	Quantity	Unit cost (HK$'000)	Total (HK$'000)	Justifications (e.g. purposes, scope of service, how it contributes to achievement of results, reasons for the quantity requested, etc.)
Electronic components for sensor development and characterization	1	100.000	100.000	See Annex 5 "Budget Justification"
PID controller	1	2.000	2.000	See Annex 5 "Budget Justification"
Patent fee	2	100.000	200.000	It is planned to apply for 2 patents for the deliverables of the project. Please see Annex 5 "Budget Justification" for more information.
External audit fee	2	20.000	40.000	See Annex 5 "Budget Justification"
Conference	2	20.000	40.000	See Annex 5 "Budget Justification" For each conference trip will only support one project team member and economy class airfare will be selected.
		Sub-total A(iii):	**382.000**	

☑ I/We confirm that for all travelling, they are at reasonable cost (e.g. economy class fare only if applicable) and are of direct relevance to the project and account for no more than 5% of the total amount of funds requested from ITF; the number of participant is not more than one person from the project team, member of which must be from the lead applicant and/or the research partner(s) (if applicable).

Note:

1. *Please indicate (by putting in [@]) where the consumables are to be covered by in-kind contribution.*

2. *Project funds cannot be used to cover general administration and office expense.*

Please refer to the list of unallowable cost items in Part C of the Guide.

3. *Services provided by the lead applicant (e.g. inter-departmental charges) are generally not allowed to be charged to the ITF. ITC may consider approving the charging of such services provided that they are (a) justifiable on grounds of operational efficiency, reliability and quality of service, etc.; (b) not general or administrative support in nature; and (c) charged at cost. The lead applicant should state clearly which services involve inter-departmental charges (if any), provide justifications and make declarations as those set out in (b) and (c).*

Additional Information: Please see Annex 5 "Budget Justification" for more information

(iv) Research Partner's Expenditure [Note]

Please provide a separate annex on the expected R&D work to be undertaken by each research partner(s) and a breakdown of the estimated project expenditure which is directly related to such R&D work with justifications.

Item	Total (HK$'000)
Expenditure incurred by Research Partner 1	770.500
Expenditure incurred by Research Partner 2	
Sub-total A(iv):	**770.500**

Note: Applicable for collaboration projects only.

☑ An annex/Annexes on research partner's expenditure is/are attached. The exchange rate used for conversion of foreign currency, if any, has been quoted in the annex(es).

(v) Administrative Overheads [Note]

Item	Total (HK$'000)
Administrative Overheads met by ITF	502.875
Sub-total A(v):	**502.875**

Note:

1. *The administrative overheads to be included in the project budget can be up to 15% of the ITF Funding requested (net of overheads).*

B. Industry Sponsorship/Other Sources of Financial Contribution

Industry sponsorship is not mandatory.

Please list all the industry sponsorship and other sources of financial contribution to be received within the Project Period, if any.

Name of Sponsor/ Contributor	Cash Sponsorship/ Contribution (HK$'000)	In-kind Sponsorship/Contribution		Total (HK$'000)
		Details (e.g. description of equipment/consumables etc. and basis of conversion to cash value)	Cash Equivalent (HK$'000)	
ABC (HK) Ltd	250.000			250.000
XYZ Industries Ltd	250.000			250.000
		Total Industry Sponsorship/Other Sources of Financial Contribution (B):		**500.000**

C. Project Income

Please list all the estimated income (e.g. licence fees, royalties, etc.) to be received, if any, and provide breakdown of each item and the basis of estimation in the following sections.

Summary:

Category	**Amount (HK$'000)**
(i) Estimated Income to be Received During Project Period	
(ii) Estimated Income to be Received After Project Completion	5,000.000

Total Estimated Project Income (C):	**5,000.000**	**(i)+(ii)**

(i) Estimated Income to be Received During Project Period

Source of Income	Basis of Projection/Assumptions	Amount (HK$'000)
	Sub-total C(i):	

(ii) Estimated Income to be Received After Project Completion

Source of Income	Basis of Projection/Assumptions	Amount (HK$'000)
Licensing fee	Market forecast by ABC (HK) Ltd Please see Annex 6 "Target Results and Benefits" for detailed market projection	2,000.000
Licensing fee	Market forecast by XYZ Industries Ltd Please see Annex 6 "Target Results and Benefits" for detailed market projection	3,000.000
	Sub-total C(ii):	**5,000.000**

D. Funding Request

	Amount (HK$'000)	
Total Project Cost (A):	4,355.375	
Total Industry Sponsorship and Other Sources of Financial Contribution (B):	500.000	
Net Amount of Funding Sought from ITF (D):	**3,855.375**	**(D) = (A)-(B)**

ITF Funding vs. Total Project Cost (expressed as a %):	**88.52%**	**(D) / (A)**

IV. Plan for Downstream Research and/or Product Development Activities

1. Please provide an estimate with reference to the scale below: Note

	1	2	3	4	5	6	7	8	9	10	11	12	
Inception of Idea	❍	√	❍	❍	❍	❍	❍	❍	❍	*	❍	❍	Prototyping and trials

Please indicate by putting '√ ' in a circle to show at what stage you are at present.
Please indicate by putting '*' in a circle to show at what stage you will be at upon project completion.

Stage	**Scale**
Inception of idea	1 – 2
Proof of concept	3 – 6
System/process optimisation	7 - 9
Prototyping and trials	10 - 12

Note: The scale is not meant to be exhaustive but rather a tool to facilitate understanding of the project.

2. Please provide information in relation to the expectations of the industry sponsors (if any) on the R&D output and the business plan where appropriate. Please enter N/A if there is no industry sponsorship.

In order to facilitate the technology transfer, regular meetings will be held between the industry sponsors and the research team. In particular, the industry sponsors will provide market information and assistance in turning the R&D output into a commercial package when it is ready for realization/commercialization.

Please see Annex 6 “Target Results and Benefits” for (1) market analysis and customer segmentation, (2) the competitive analysis in assessing the strengths and weaknesses of existing technologies in the market, (3) the market positioning of the proposed system, (4) the SWOT analysis of the project deliverables, and (5) potential technology transfer plan.

3. Please elaborate on the overall plan for further downstream research and/or development of new products or services, including activities to be undertaken to:
   - conduct downstream research;
   - through the development of new products or services, realise the application of the R&D deliverables in the public sector i.e. Government Departments, public bodies, trade associations, charitable organisations; and/or
   - turn the R&D results into new products or services for marketing in the commercial world, e.g. target users, marketing strategy including market segmentation and analysis of 4Ps in marketing (Products, Price, Place, Promotion), etc.

   Please also provide specific timeframe and details of further downstream research and/or development of new products or services.

The project team intends to conduct downstream research in order to enhance the developed system with additional R&D work targeting smart building applications in the first 6 months after project completion, so as to turn the R&D results into a complete solution for the public sectors and the industry sectors. Please see Annex 6 “Target Results and Benefits” for (1) market analysis and customer segmentation, (2) the competitive analysis in assessing the strengths and weaknesses of existing technologies in the market, (3) the market positioning of the proposed system, (4) the SWOT analysis of the project deliverables, and (5) potential technology transfer plan.

4. Please provide information in relation to the future positioning of the technology/product in the market and potential industry partners for technology transfer/manufacturing/sales, etc.

Please see Annex 6 “Target Results and Benefits” for (1) market analysis and customer segmentation, (2) the competitive analysis in assessing the strengths and weaknesses of existing technologies in the market, (3) the market positioning of the proposed system, (4) the SWOT analysis of the project deliverables, and (5) potential technology transfer plan.

5. Please analyse the strengths/weaknesses/opportunities/threats (i.e. SWOT analysis) of the project deliverables.

Please see Annex 6 “Target Results and Benefits” for (1) market analysis and customer segmentation, (2) the competitive analysis in assessing the strengths and weaknesses of existing technologies in the market, (3) the market positioning of the proposed system, (4) the SWOT analysis of the project deliverables, and (5) potential technology transfer plan.

6. Please indicate whether you intend to apply for further phases of funding under the ITF upon completion of this project.

☑ Yes. (Please provide details)

The project team intends to apply for collaborative research projects under ITF to enhance the developed system with additional R&D work targeting industry sectors.

☐ No.

v. Relevance with Government Policies or in Overall Interest of the Community

1. Please explain how the R&D project can support major Government initiatives/policies of Hong Kong.

The Government has an initiative to achieve energy saving target for the government buildings before 2030. The proposed solution may facilitate energy efficient building by adaptively control the energy consumption of HVAC with similar thermal comfort level. The project deliverables would be a platform for further research and development of IoT sensor, which would be synergic to this project for more optimizing energy saving under different application scenarios.

(Ref: https://www.enb.gov.hk/sites/default/files/pdf/EnergySavingPlanEn.pdf).

2. Please explain how the R&D project can provide opportunities for training of engineering/scientific/R&D personnel in Hong Kong (or facilitate exchange with R&D personnel outside Hong Kong).

The proposed system can provide training for 4 project members from Hong Kong R&D University and 2 project members from Hong Kong Scientific University in the R&D of data analytics, adaptive control system and sensor design.

3. Please explain how the R&D project can contribute to the upgrading of the industry.

On one hand, the project would train up local engineering and scientific personnel in the areas of adaptive control on IoT, who can then be recruited by the industry to carry out R&D in Hong Kong. On the other hand, the project would be a platform for facilitating further science and technology development in IoT sensors for smart energy efficient building solution, contributing innovative product and novel technological solutions of industries.

4. Please explain how the R&D project can bring social benefit.

There would be significant social benefit of new smart energy efficient buildings. According to the Environment Bureau of Hong Kong government in 2015, about 54% of Hong Kong total annual energy use is in the form of electricity consumption, and buildings account for about 90 % of the city's electricity usage. Therefore, promoting the innovations and technologies to save building energy would be critical to energy saving. This can facilitate the achievement of the target of Energy Saving Plan for the Built Environment 2015~2025+

(Ref: https://www.enb.gov.hk/sites/default/files/pdf/EnergySavingPlanEn.pdf).

VI. IP Rights and Benefit Sharing

1. Please explain whether the R&D will lead to patent(s) or the R&D deliverables will be protected by other IP rights.

   ☑ Yes. (Please set out plan for application for grant of patent and whether the R&D deliverables will be patentable)

   It is planned to apply for 2 patents for the deliverables of the project.

   Please see Annex 5 "Budget Justification" for more information.

   ☐ No.

2. Please indicate whether IPs/patents not wholly owned by the lead applicant will be used in the R&D project, and if so, whether consent/licence for use of such IPs/patents has been/will be obtained.

   ☐ Yes. (Please provide details)

   ☑ No.

3. Please set out the proposed ownership and/or right to use the IPs of the deliverables arising from the current project.

   The IPs generated from this project will be vested with the Hong Kong R&D University. Unrestricted use of the technology would be allowed for relevant Government departments.

4. Please provide details and justifications for the sharing of IP benefits, if any, among all parties concerned.

The IPs generated from this project will be vested with the Hong Kong R&D University. The revenues and benefits arising therefrom will be shared with the Hong Kong Scientific University on an equitable basis.

VII. Management Capability

1. Please set out the organisational structure and division of responsibilities among parties concerned to undertake/manage/market, etc. the project.

Lead Applicant

The project will be conducted by the Hong Kong R&D University, including the management and administration of the project, as well as the development of the system.

Research Partner(s) *(only applicable to collaboration projects)*

Hong Kong Scientific University will provide support in the development and the evaluation of the low cost power efficient environmental sensors.

Other Related Parties

The project has gained support from the HK ABC Association for the provision of a trial site as well as the industry to provide market information when the product is ready for realization/commercialization.

2. Please provide details of all relevant parties involved in the downstream research and/or development of new products or services.

The project has gained support from the industry, namely ABC (HK) Ltd and XYZ Industries Ltd to provide market information and suggestions for the future positioning of the deliverables in the market.

HK ABC Association and the Jockey Club Charitable Trust will provide user feedback during the trial to facilitate the future realization/commercialization of the deliverables.

3. Please advise whether there are any completed or on-going ITF/non-ITF projects in the same/related areas undertaken by the Project Coordinator and the research team members.

☑ Yes. (Please set out details of the project as follows)

Project Title	Project Ref. No. (for ITF projects only)	Commencement Date	Completion Date
Novel Adaptive Control Algorithm of HVAC for Energy-efficient Buildings	ITS/999/19	12 Aug 2020	11 Aug 2021

☐ No.

4. Please indicate if the Project Coordinator has sufficient capacity to manage the project satisfactorily (e.g. the number of R&D projects under his purview or any other significant commitments during the Project Period).

Prof. Tai-man CHAN (PhD in Computer Science, Harvard) has over 20 years of R&D experience in the areas of signal processing, information theory, and digital communication.

Prof. Chan has sufficient capacity and capability to handle the project satisfactorily based on the number of R&D projects under his purview. (Please see CV in Annex 3 for more information).

Part D Attachments for the Application

Please number the supporting documents to be submitted together with this form as annexes, and provide the file description.

Annex No.	File Name	File Description
1	Technical Background	Details of previous researches in relation to this proposed project.
2	Specifications of the deliverables	Details of the deliverables of this proposed project.
3	CV	CVs of the Project Coordinator and the Research Team
4	Project Implementation Plan	The implementation plan of this proposed project.
5	Budget Justification	Breakdown and justifications for the budget of this proposed project.
6	Target Results and Benefits	Planning for further downstream research

I/We have carefully read and fully understand the ***'Guide to Filling in the Application Form for the Innovation and Technology Support Programme (ITSP) (Mid-stream, theme-based)'*** and the information in this form.

I/We certify that all the information provided in this form is true, complete and accurate. In the event that any information is found untrue, incomplete or inaccurate in future, ITC reserves the right to revoke its approval of any application, withdraw any grant approved, request for refund to the Government of any payment already made, and subject the case to legal proceedings.

I/We agree that information provided in this form will be used and/or disclosed by the Government to relevant parties to process the application, to conduct research and survey, and if the application is successful, to monitor the project, to exercise its rights and powers in relation to the project, and for other related purposes.

I/We declare and undertake that the lead applicant and research partner(s) for collaboration project shall conform in all respects with all legislation (including without limitation the Law of the People's Republic of China on Safeguarding National Security in the Hong Kong Special Administrative Region), regulations and by-laws of the Hong Kong Special Administrative Region in carrying out the project.

Lead Applicant

Authorised Signature for and on Behalf of the Lead Applicant	
Name	Mr. CHAN Siu-ming
Post Title	Director, Office of Knowledge Transfer and Research
Tel	+852-2333-3333
Name of Lead Applicant	Hong Kong R&D University
Date	01 / 09 / 2023

- Chop -

Lead Applicant Chop