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IRAS e-Tax Guide

Research and Development Tax Measures
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1 Aim

- 1.1 This e-Tax Guide sets out the relevant research and development (“R&D”) tax measures as announced in Budgets 2008 to 2020 (refer to Annex A). It clarifies the existing definition of R&D and its qualifying criteria. The e-Tax Guide helps taxpayers self-assess if their R&D activities are qualifying R&D activities for tax purpose.

2 At a glance

- 2.1 The R&D tax measures are targeted at encouraging businesses to build up R&D capabilities in Singapore. A taxpayer who undertakes qualifying R&D activities may benefit from the R&D tax measures.
- 2.2 The taxpayer need not apply to any government agency for these R&D tax measures¹. The taxpayer must self-assess if his R&D activities are qualifying R&D activities for tax purpose and if so, make the relevant claims in the annual tax return.
- 2.3 This e-Tax Guide provides information in the following areas:
- (a) Part A: Qualifying R&D project
 - (b) Part B: R&D Tax Deductions
 - (c) Part C: Administrative Procedures
- 2.4 The definition of a qualifying R&D project covered in this e-Tax Guide is also relevant to the R&D claims made under the Productivity and Innovation Credit (“PIC”) Scheme².

¹ This excludes R&D projects approved under section 14E of the Income Tax Act 1947 (“ITA”) on or before 31 March 2020.

² This refers to claims made under section 14D(2) of the ITA. Please refer to the e-Tax Guide on PIC.

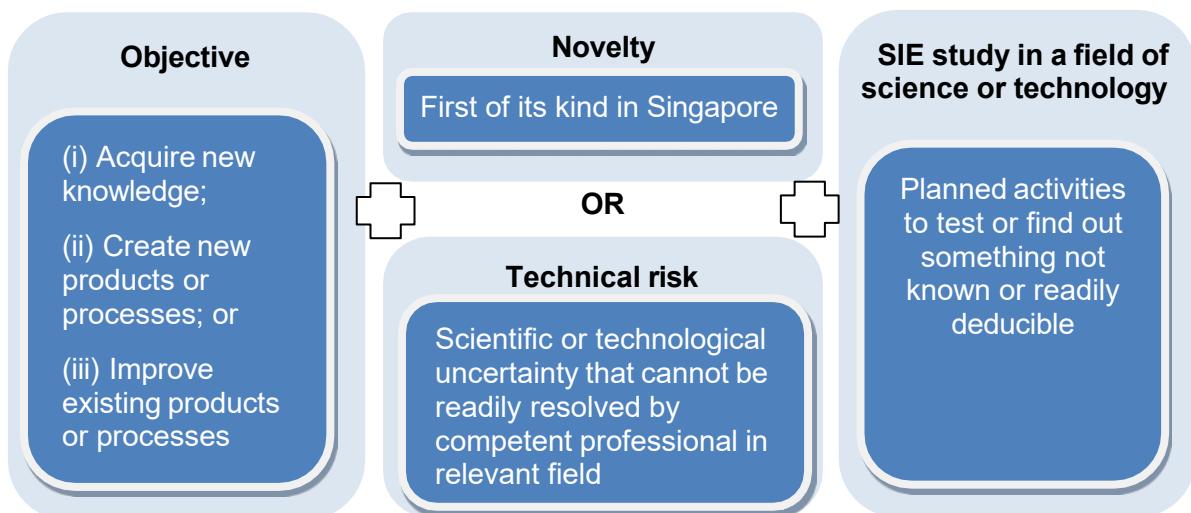
PART A: QUALIFYING R&D PROJECTS

3 What is qualifying R&D?

3.1 Three requirements of qualifying R&D

3.1.1 A qualifying R&D project must fall within the definition of “R&D” under section 2³ of the ITA. There are three requirements⁴:

- (a) The **objective** is to –
 - (i) Acquire new knowledge;
 - (ii) Create new products⁵ or processes; or
 - (iii) Improve existing products or processes;
- (b) It involves **novelty or technical risk**; and
- (c) It is a **systematic, investigative and experimental (“SIE”)** study in a field of **science or technology**.



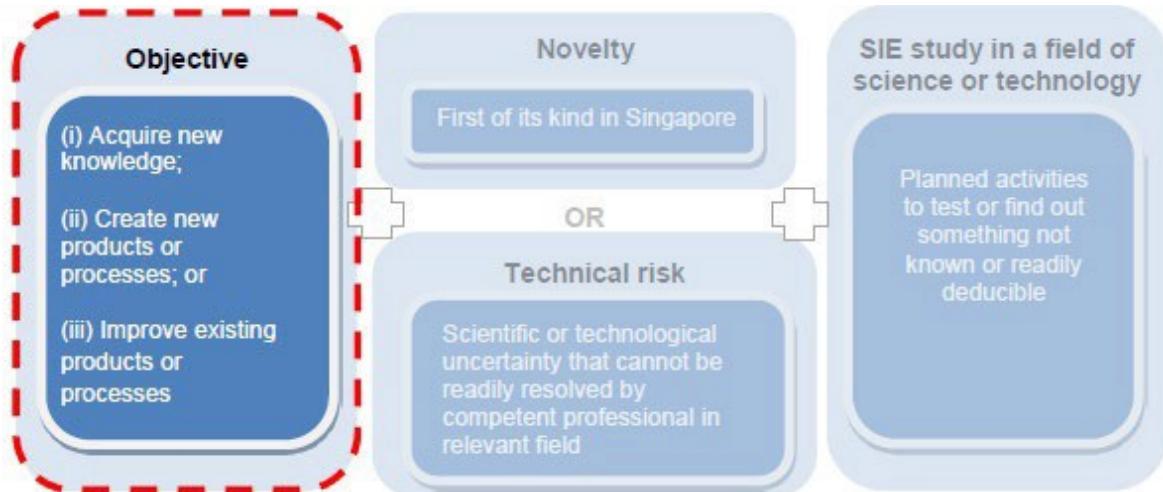
³ Under section 2 of the ITA, R&D is any systematic, investigative and experimental study that involves novelty or technical risk carried out in the field of science or technology with the object of acquiring new knowledge or using the results of the study for the production or improvement of materials, devices, products, produce, or processes, but does not include certain activities which are specifically excluded.

⁴ The evaluation of all types of R&D projects (e.g. basic research, applied research, experimental development, feedback R&D etc.), will be based on whether the projects meet all the three requirements.

⁵ “Products” encompass consumer products and product range, as well as other products used within the business such as manufacturing equipment. It also includes materials, devices and services.

- 3.1.2 In addition, some activities are specifically excluded from the scope of qualifying R&D. The exclusions are discussed further in paragraph 4.

3.2 Objective

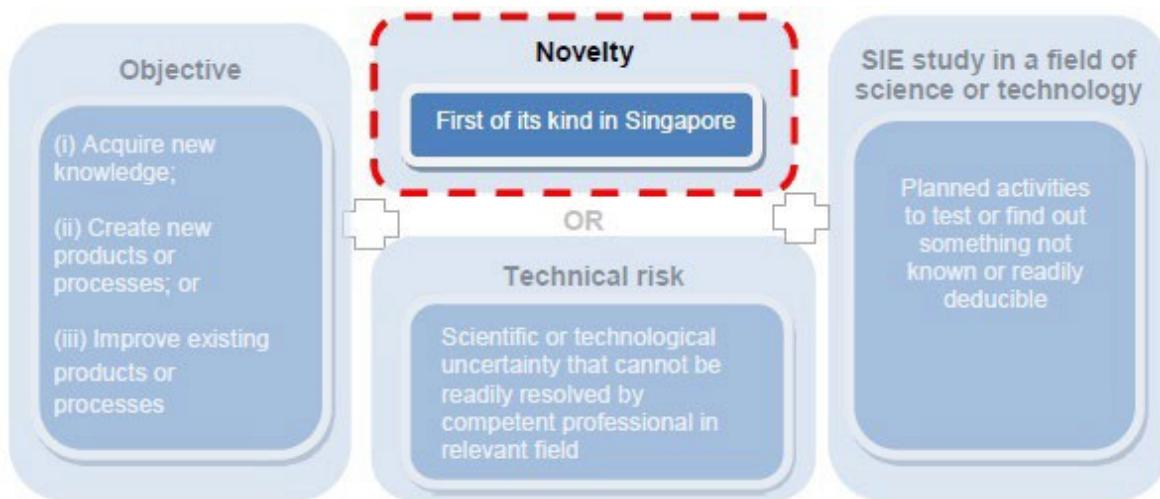


- 3.2.1 The objective of the study refers to the primary purpose of the R&D project. As the objective is the reason why the R&D project is undertaken, it must be clearly set out prior to the commencement of the R&D project. An R&D objective should state the scientific or technological challenges that need to be overcome in order to close that gap between the desired outcome as well as the state of knowledge and technology existing at the time of commencement of the R&D project.
- 3.2.2 An R&D project may be a part of a larger commercial project. However, that does not make the other parts of the commercial project a qualifying R&D project if those other parts are not undertaken wholly or mainly to support the R&D project.
- 3.2.3 For example, a company's commercial project may be to substantially increase convection oven sales by improving the performance of its convection ovens. The objective of the R&D project is to overcome the technical challenge of preventing overheating in an oven that can cook twice as fast as any other convection oven on the market. Provided the project meets the other requirements to qualify as R&D (i.e. SIE and novelty/technical risk), the aspects of the R&D project that relate to overcoming this technical challenge will qualify as R&D (e.g. the company may need to experiment with new materials for the oven's outer casing in order to accommodate quicker changes in temperature). However, activities that do not address the R&D objective (e.g. market surveys on whether consumers prefer ovens that can heat faster) would not qualify as R&D.

RECAP: Objective

- Has to be clearly **set out prior to commencement of project**.
- Has to state the **scientific or technological challenges that need to be overcome**.
- Aims to close the gap between desired outcome and **state of knowledge and technology existing at the time of commencement of project**.

3.3 Novelty



- 3.3.1 Novelty exists when there is something new in relation to the creation or improvement of products, processes or knowledge. “New” refers to the **first of its kind in Singapore** (excluding content-based products such as movies, electronic versions of print media etc.⁶). Where a product, process or knowledge is already available outside Singapore, the mere importation of that product, process or knowledge into Singapore, without undertaking a SIE study⁷, would not qualify as R&D.
- 3.3.2 The creation or improvement of products, processes or knowledge involves more than minor or routine upgrading. There is no improvement if:
- × the enhancement arises from taking existing scientific or technological knowledge/ capability and deploying it in a new context with only minor or routine changes; or

⁶ The production of such content-based products also does not involve SIE in the field of science or technology.

⁷ Refer to paragraph 3.5 below for explanation of what a SIE study involves.

- ✗ the activity simply brings the taxpayer in line with current knowledge or capability⁸, even though such knowledge or capability is new to the company.

An example is the development of a Radio Frequency Identification (“RFID”)⁹ mobile device to read RFID tags for capturing visitors’ data in an exhibition hall. As the use of RFID in this new context only requires minor changes for which the outcome is readily deducible (i.e. no SIE involved), the development would not qualify as R&D¹⁰.

3.3.3 Examples of novelty include:

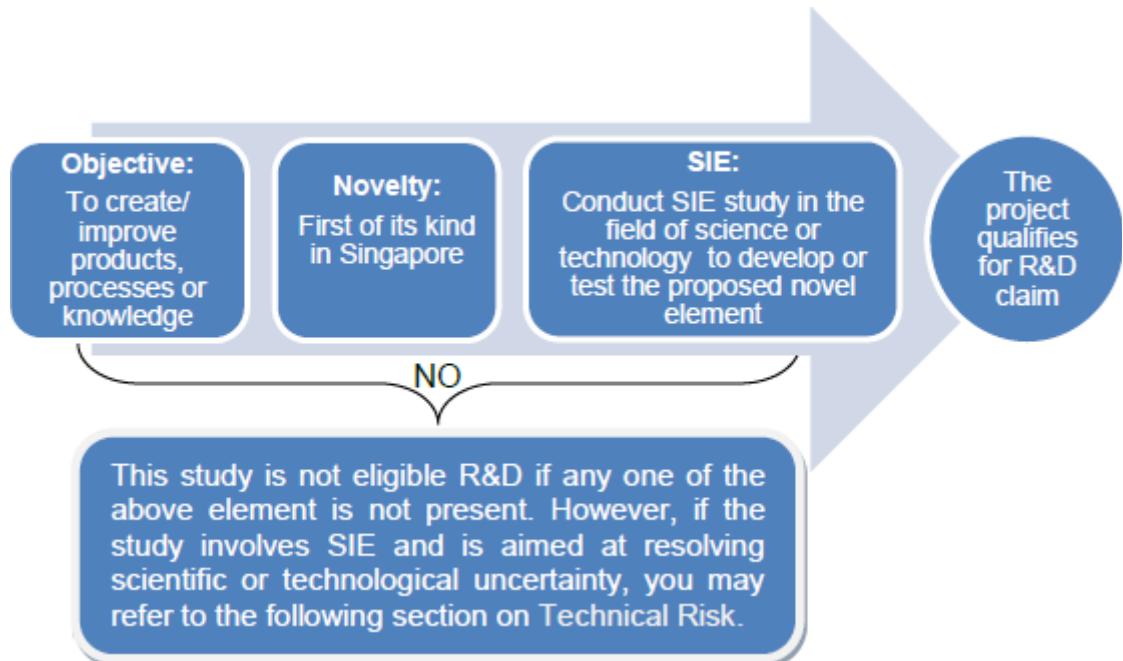
- ✓ Creation of a new process to produce a product with similar or improved specifications as existing products.
- ✓ First time use or adaptation in an industry of technology or process that existed in another industry.
- ✓ Use of existing technology (excluding off-the-shelf technologies) to produce new goods or deliver services in new ways.
- ✓ First time use of material already used in other applications to produce an existing product with similar or improved specifications.

⁸ Refer to paragraphs 3.5.3 and 3.5.4 for information on what is considered knowledge or capability that is reasonably available at the time of commencement of R&D activities.

⁹ RFID is a wireless communication technology that enables the unique identification of tagged objects.

¹⁰ However, if the development of a new use of an existing technology (such as RFID) is able to meet the three requirements of qualifying R&D, it may qualify as R&D. In such a case, besides explaining what the novel use is, taxpayers should also sufficiently explain and show what is unknown or not readily deducible about the application of the existing technology such that it required a SIE study to find out.

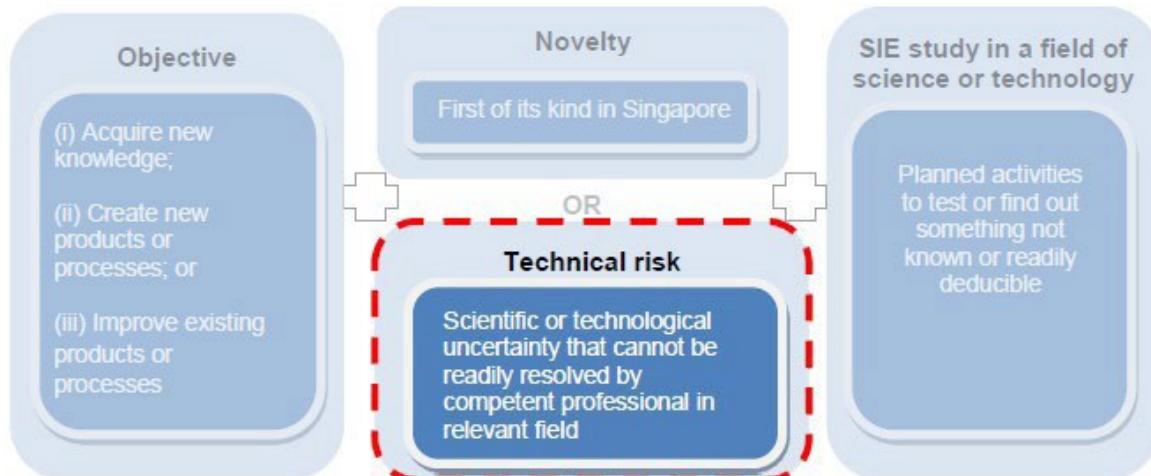
- 3.3.4 To qualify for R&D claims under the “novelty” requirement, the project must have three elements:



RECAP: Novelty

- Something new (**first of its kind in Singapore**) in relation to the creation or improvement of products, processes or knowledge.
- The creation or improvement must involve **more than minor or routine upgrading**.

3.4 Technical risk



- 3.4.1 A project involves technical risk if there is **scientific or technological uncertainty** that **cannot be readily resolved by a competent professional** in the relevant field of science or technology at the time of commencing the R&D activities.
- 3.4.2 **Scientific or technological uncertainty** exists when there is a gap between the current state of scientific or technological knowledge and the intended outcome of the project. This gap is not merely that the outcome is not known but also that it is something that cannot be readily resolved by a competent professional based on knowledge, information or experience that is reasonably available at the time of commencing the R&D activities¹¹.
- 3.4.3 A **competent professional** is a person who:
 - ✓ is knowledgeable and experienced in the relevant field of science or technology;
 - ✓ possesses the relevant qualifications and experience necessary to participate in the relevant field with a reasonable level of skill;
 - ✓ is aware or possess the resources to be aware of the current state of knowledge and information; and
 - ✓ may or may not be your employee.
- 3.4.4 For example, a company that carries out sound-proofing of a studio may use an established pattern, or follow routine methods to do so. Initially, it may not know the exact combination of acoustic materials to use that would achieve complete block-out of sound for the studio. However, using standard methods of installation and adjusting the variation of commonly used materials is likely to achieve the outcome. There is no technical risk and SIE¹² because the sound-proofing of the studio could be made with reasonable certainty.
- 3.4.5 Examples of technical risk include:
 - ✓ Use of new materials or ingredients to improve functionalities of existing products.
 - ✓ Use of new materials or ingredients to create new products.
 - ✓ Production of smaller or lighter products in the product class while retaining functionalities.
 - ✓ Fundamental change of the physical characteristics (beyond changes that are merely cosmetic) of products.

¹¹ Refer to paragraphs 3.5.3 and 3.5.4 for what is considered knowledge, information or experience that is reasonably available at the time of commencement of the R&D activities.

¹² Since the sound-proofing was achieved using standard methods of installation, the knowledge of how to achieve the outcome is reasonably available and hence, there is no SIE.

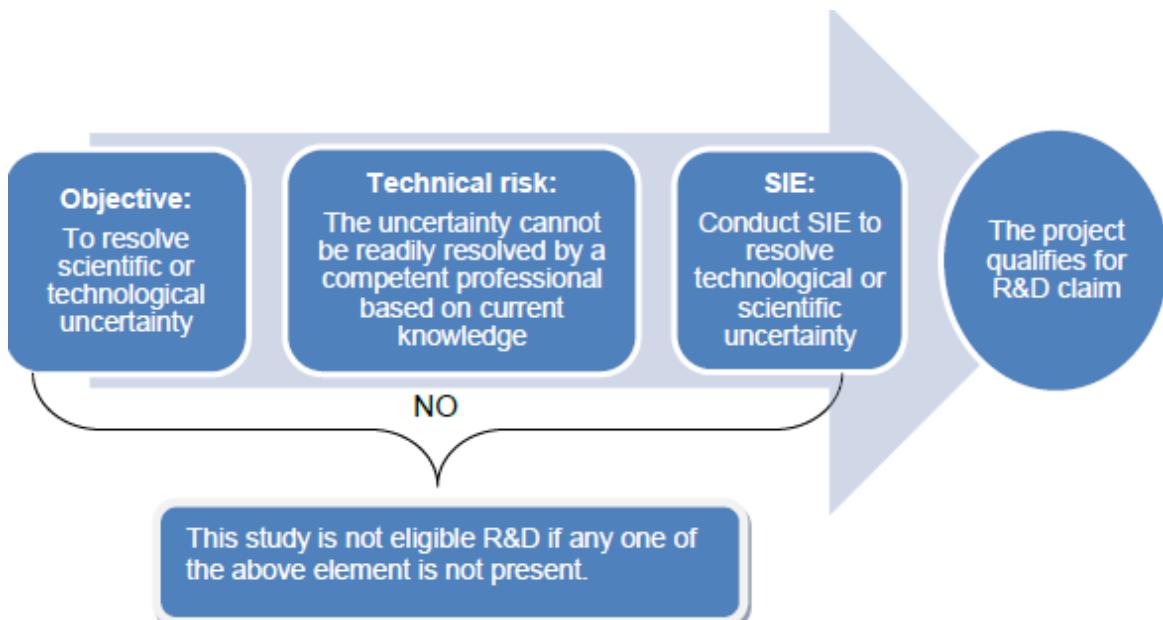
- ✓ Integration of two or more technologies to create new products or processes or improve existing products or processes, where none existed before and there is scientific or technological uncertainty of how to achieve the intended outcome.

3.4.6 Examples where there is no technical risk:

- ✗ Integration of two or more technologies into an established pattern and using known methodologies which involve little or no scientific or technological uncertainty, to create new products or processes or to improve existing products or processes.
- ✗ Fine-tuning or tweaking of existing products using standard methods.
- ✗ Customisation of existing tools or knowledge for a taxpayer's business. There is no technical risk as the tools or knowledge may be adapted by competent professionals with reasonable certainty that the approach will work.

3.4.7 Where the expected outcome is achieved easily (e.g. success after first trial), it is an indication that there may not be the element of technical risk involved.

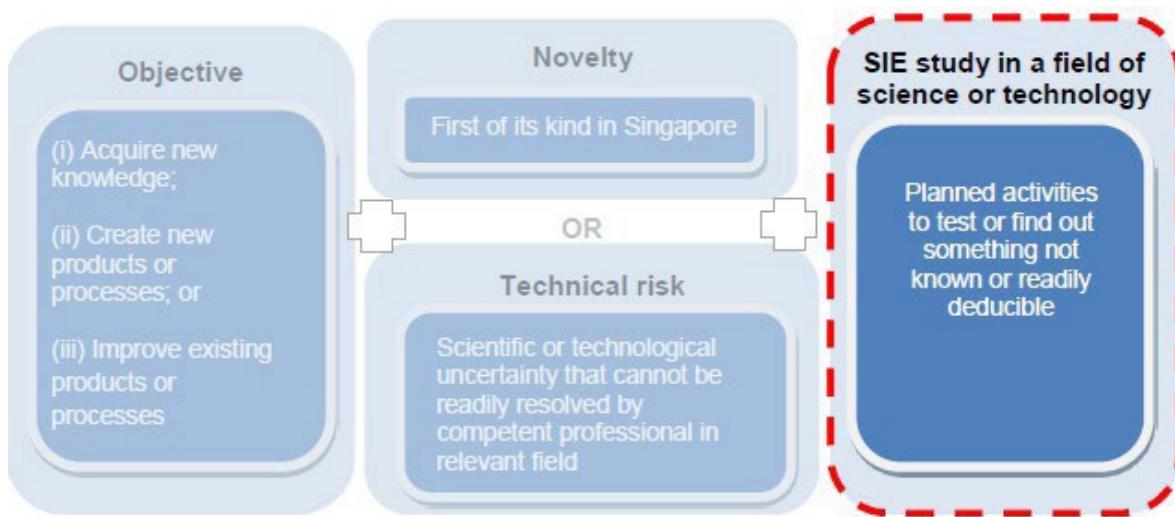
3.4.8 To qualify for R&D claim under the "technical risk" requirement, the project must have three elements:



RECAP: Technical risk

- **Scientific or technological uncertainty that cannot be readily resolved by a competent professional in the relevant field of science and technology at the time of commencing R&D activity.**
- Scientific or technological uncertainty arises from a gap between the intended project outcome and the state of scientific or technological knowledge, information or experience that is reasonably available at the time of commencing the R&D activities.

3.5 Systematic, investigative and experimental (“SIE”) study in the field of science or technology



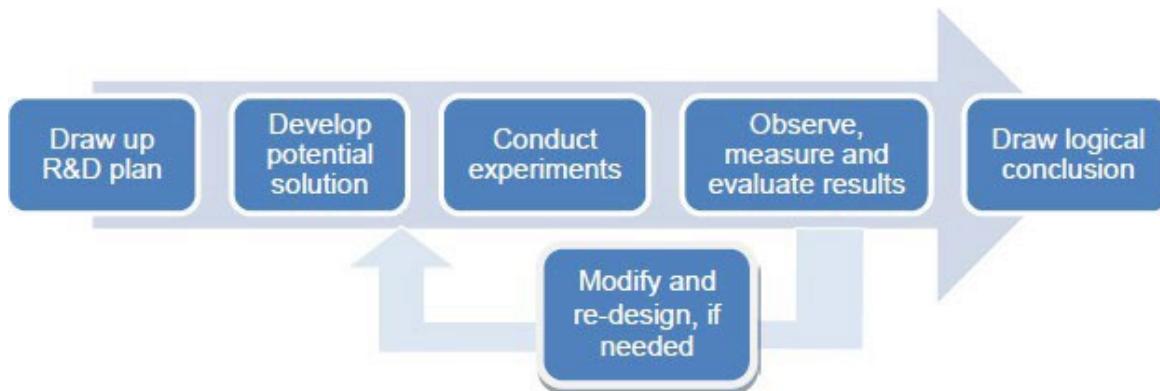
3.5.1 A SIE study refers to a series of planned activities to test or find out **something that is not known or readily deducible** in the field of science or technology (i.e. the outcome cannot be known or determined prior to the commencement of the study because the knowledge, information or experience to achieve the outcome is not reasonably available). It comprises all of the following characteristics:

- (a) **Systematic** – A planned and orderly approach of the steps or activities to be taken in the study. Activities undertaken are documented such that another person in the same field can reproduce the same results by following the same procedures.
- (b) **Investigative** – Activities undertaken to explore and uncover information to help in the understanding of the problem and to find out how to close the gap between the desired outcome and the state of scientific or technological knowledge prior to the commencement of the study. It is not simply to confirm information which is already known or a fact.

- (c) **Experimental** – A series of structured steps undertaken to test the potential solution¹³ for solving a technical problem or creating a new thing. An iterative process is often needed because the outcome is unknown and results from each round of testing would provide you with more knowledge than before.
- 3.5.2 A SIE study is undertaken to test a potential solution, to generate new knowledge to overcome the unknown. If there are publicly known ways to overcome the challenges, then it is unlikely that the study will qualify as a SIE study.
- 3.5.3 Examples of scenarios where knowledge, information or experience is not reasonably available (i.e. SIE study required):
- If you need to design and conduct a study to resolve the scientific or technological challenges, then it is more likely that the outcome cannot be readily determined or known based on current knowledge, information or experience prior to the study.
 - Knowledge, information or experience that is not available because they are held closely by a competitor (e.g. trade secrets or proprietary information) and a study is needed to uncover the knowledge or information.
- 3.5.4 Examples of scenarios that are likely to belong to the category of known or readily deducible as relevant knowledge and information is reasonably available (i.e. SIE study not required):
- Information of how something could be done is readily found in public domain (e.g. internet) at the commencement of the study.
 - Information of how something could be done is readily procured from experts in the relevant field of science or technology (e.g. consultants, academics).
- 3.5.5 In conducting a SIE study, a taxpayer is expected to perform some, if not all of the following activities (as depicted in the diagram below):
- Draw up an R&D plan, stating project timelines and milestones.
 - Undertake research to develop the potential solution.
 - Conduct testing using a systematic approach.
 - Deploy an R&D team (e.g. R&D project manager, engineers or other suitably qualified personnel in the relevant field) to conduct the work.
 - This need not be a full-time team devoted solely to the R&D project. It is sufficient to show the roles and responsibilities of the team working on the project.

¹³ There is no known or readily deducible solution if the knowledge to achieve the outcome is not reasonably available.

- Record test results.
- Analyse and evaluate test results.
- Consider and document steps taken to improve chance of success for subsequent testing. Modify approach and re-test, as needed.
- Evaluate and record conclusion of the project.



- 3.5.6 Activities that support the R&D work, such as testing, data collection, research in social sciences or humanities, may qualify for the R&D tax measures if they are undertaken wholly or mainly for the purpose of the qualifying R&D project.
- 3.5.7 Examples of SIE activities include:
- ✓ Iterative processes where alternative methods are evaluated, tested, modified and tested again repeatedly.
 - ✓ Systematic approaches to test the potential solutions. E.g. use of modelling, simulation, systematic trial and error methodology.
 - ✓ Evidence of unsuccessful attempts and steps taken to improve the chance of success for subsequent attempts. Such evidence is a persuasive indicator that the outcome is not readily deducible.
- 3.5.8 Examples where there is no SIE study:
- ✗ Experiments carried out to confirm or demonstrate what is already known.
 - ✗ Random trial and error alone with no structured manner of investigation and testing.
- 3.6 R&D tax benefits may be claimed regardless of the outcome of the qualifying R&D as it is recognised that R&D activities need not always result in successful outcomes.

4 What does not qualify as R&D?

4.1 An activity will not qualify as R&D if it falls within the list of activities stated below¹⁴.

- (a) Quality control or routine testing of materials, devices or products.

E.g. Testing of an existing rejuvenating cream for regulatory requirement, with no enhancement to the cream; and Tests to commission new equipment, calibrate, fine-tune, or optimize processes or production systems.

- (b) Research in the social sciences or the humanities.
- (c) Routine data collection.
- (d) Efficiency surveys or management studies.
- (e) Market research or sales promotion.

E.g. Market survey or researching market niches in which R&D might benefit a company, examination of a project's financial, marketing, and legal aspects or administrative activities are not eligible activities.

- (f) Routine modifications or changes to materials, devices, products, processes or production methods.

E.g. Reducing the concentration of sugar in a drink product to make the drink less sweet.

- (g) Cosmetic modifications or stylistic changes to materials, devices, products, processes or production methods.

E.g. Creating new colours, shapes and designs of frames for spectacles.

4.2 These activities are excluded from the definition of R&D for the following reasons:

- (a) To focus on R&D in the field of science or technology; and
- (b) To distinguish R&D from routine improvements. Enterprises need to periodically improve their products or processes. The R&D tax measures are not intended to apply to improvements of products and

¹⁴ These activities are specifically excluded from the definition of "R&D" under section 2 of the ITA.

processes that would have occurred in the ordinary course of the taxpayer's work.

- 4.3 Where a project does not meet the requirement of qualifying R&D and thus the R&D tax deduction, the relevant expenses may still qualify for normal tax deduction, subject to the tax deduction rules under sections 14 and 15 of the ITA. This means that the expenses have to be revenue expenditures that are wholly and exclusively incurred in the production of income, before they can qualify for tax deduction. The tax deduction will be at 100% of the expenses.

5 Start and end of an R&D project

- 5.1 It is important to identify the start and end of the project because only expenditures related to the project are eligible for R&D deductions.
- 5.2 An R&D project starts when a scientific or technological objective of the project has been identified, and activities directly undertaken to address the scientific or technological objective commence.
- 5.3 Generally, the start of a feasibility study will not be considered as the start of an R&D project. An example is the cost and benefit study carried out before the decision on the R&D project is made. However, once the scientific or technological objective has been identified and if in the course of the R&D project, additional feasibility studies are undertaken to explore alternative solutions, such studies are considered an integral part of the R&D project.
- 5.4 The project ends when one of the following occurs (whichever is the latest):
- (a) All activities related to testing the potential solution are completed and a conclusion reached (either succeeding or failing to resolve the scientific or technological challenges); or
 - (b) When a prototype or pilot plant with all the functional characteristics of the final product or process is successfully tested and validated; or
 - (c) When the study is terminated.
- 5.5 A prototype is an original model constructed to include all the functional characteristics of the new product and is generally built for R&D purposes. The completion of successful testing of the prototype could be the end of the R&D project. In some instances, modification work may be required to make the prototype available for sale or implement the production process. Where such modification work entails further R&D that meets all elements of a qualifying R&D, it may be considered as part of the qualifying R&D project or as a separate qualifying R&D project.

- 5.6 The experimental phase of pilot plant is part of an R&D if the principal purposes are to obtain experience and to compile data to be used in the R&D. For example, in some pharmaceutical R&D projects, a pilot plant may be built to produce small-scale quantity of experimental drugs for use in clinical trial prior to obtaining regulatory approval. When the pilot plant switches to operate as a normal commercial production unit, the activity would no longer be considered R&D.
- 5.7 An example of start and end of project is provided below.

Company A aims to produce an improved sportswear fabric with uniform two-dimensional stretch in length and width. The current process of using existing yarns can only result in fabrics that stretch on warp (length) but insufficiently on weft (width). The company plans to undertake a project to produce fabric with 25% stretch on both warp and weft, and the fabric specialists are uncertain how this can be achieved.

The R&D project starts with the identification of the scientific objective (fabric with 25% stretch on both warp and weft) and commencement of work to address the objective. This includes planning of the project and developing the potential solution.

The R&D project ends when the trials establish that the new yarn and process produce a fabric that meets the company's technical requirements. Subsequent work, such as demonstrating the new process to the company's board and customers and work to patent, market and tool-up for full-scale production, are ineligible activities.

6. Examples of qualifying and non-qualifying R&D

- 6.1 Annex B provides examples of qualifying and non-qualifying R&D. These examples show how the R&D principles are applied and the type of information and documentation provided by the taxpayers.
- 6.2 The examples are of general nature and there may exist variations to these examples that could lead to a different conclusion.

PART B: R&D TAX DEDUCTIONS

- 7. Who is eligible to claim the tax benefits?**
 - 7.1 Taxpayers who incur the R&D expenditures and are the beneficiaries of the R&D activities may claim R&D tax deductions.
 - 7.2 A taxpayer who benefits from R&D activities generally:
 - (a) Bears the financial burden of carrying out the R&D activities; and
 - (b) Effectively owns and is able to commercially exploit the know-how, intellectual property or other results of the R&D activities.
 - 7.3 The taxpayer may perform the R&D activities on his own account or outsource them to someone who performs the R&D activities on his behalf (i.e. an R&D service provider).
 - 7.4 An R&D service provider refers to a taxpayer who is in the trade or business of providing R&D services. It also includes a taxpayer who performs R&D as one of its activities, and the R&D activity may not be the taxpayer's principal business activity. It does not matter whether the services are provided to related parties.
 - 7.5 An R&D service provider may undertake an R&D project on his own account to improve his products or service offerings to his customers. Such R&D expenditure incurred may qualify for R&D tax benefits if the conditions under paragraph 7.2 are met.
 - 7.6 If, however, an R&D project is undertaken by an R&D service provider on behalf of his customers on a cost plus basis or under any other fee arrangement, the R&D service provider cannot claim R&D tax benefits since he is not the beneficiary of the R&D activities. The R&D expenditure incurred by him would be allowable under section 14 instead of section 14C of the ITA¹⁵.
- 8. What is qualifying R&D expenditure?**
 - 8.1 A taxpayer may undertake R&D work directly, outsource it to an R&D service provider, or participate in an R&D cost-sharing agreement ("CSA"). Such R&D work may be carried out wholly in Singapore, or wholly outside Singapore ("normal R&D projects"). It may also be carried out partly in Singapore and partly outside Singapore ("mixed R&D projects"). The

¹⁵ Section 14C(1) of the ITA specifically excludes any amount which is allowable as a deduction under section 14.

following sections set out the tax deduction rules under the different R&D arrangements.

- 8.2 An overview of the R&D tax deductions for normal and mixed R&D projects is provided in Chart A and Chart B respectively (after paragraph 8.9).
- 8.3 Tax deductions on qualifying R&D expenditure are provided for under sections 14C(1) (i.e. 100% deduction), 14D(1) (i.e. additional 50% deduction from Years of Assessment (“YAs”) 2009 to 2018; additional 150% deduction from YAs 2019 to 2025), and 14D(2) (i.e. PIC deduction¹⁶) of the ITA.
- 8.4 R&D expenditure¹⁷ that qualifies for the 100% deduction shall exclude:
 - (a) Expenditure that is subsidised by grants or subsidies from the Government¹⁸;
 - (b) Expenditure that is allowable as a deduction under section 14 of the ITA;
 - (c) Expenditure that is specifically prohibited for deduction under section 15 of the ITA¹⁹, such as share option costs, depreciation etc.;
 - (d) Capital expenditure on plant, machinery, land or buildings, or acquisition of rights for the purpose of the R&D project.

The same rules apply to a payment made under a CSA (“CSA payment”). IRAS may require the taxpayer to provide a breakdown of the expenditure for examination.

- 8.5 A CSA payment refers to the R&D expenditure that is allocated to and borne by the taxpayer under the CSA. It excludes any payment for the right to be a party to the CSA (i.e. buy-in payment).

¹⁶ Please refer to the e-Tax Guide on PIC.

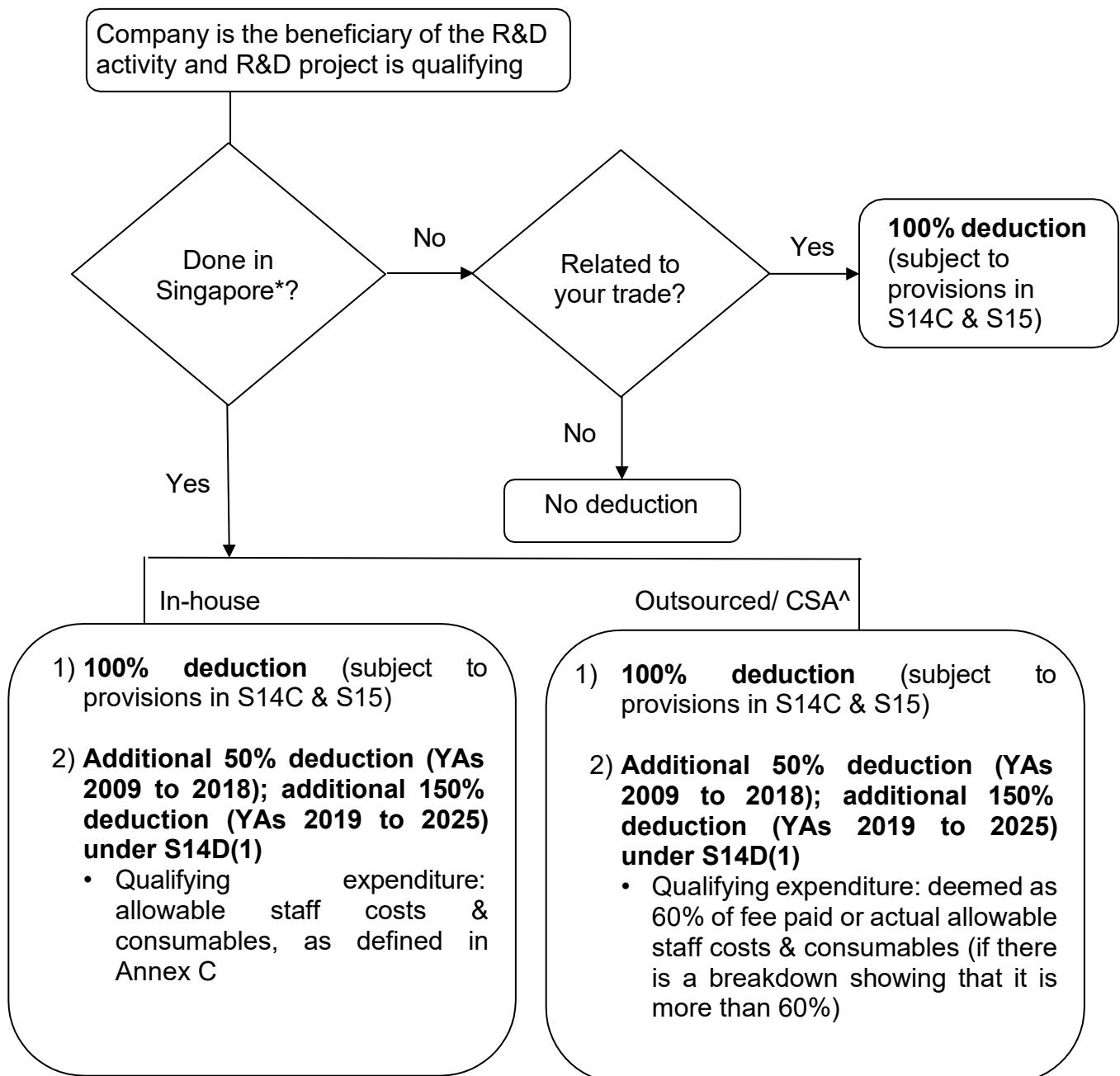
¹⁷ Qualifying expenditure incurred before the commencement of a trade or business will be deemed to be incurred on the first day on which the business commences. Please refer to the e-Tax Guide “Income Tax: Treatment of Certain Expenses Incurred Prior to the Commencement of a Business Activity”.

¹⁸ For the purposes of this e-Tax Guide, the term “Government” in relation to a grant or subsidy includes any statutory board.

¹⁹ Unless they fall within sections 15(1)(b) and (d), in accordance within section 15(2) of the ITA.

- 8.6 R&D expenditure that qualifies for the additional deduction and PIC deduction (see paragraph 8.3) refers to staff costs or consumables as defined in Annex C. It excludes expenditure that is subsidised by a grant or subsidy from the Government.
- 8.7 Where R&D is outsourced, the amount of expenditure that is eligible for the additional deduction and PIC deduction (see paragraph 8.3) is generally 60% of the fee paid for the outsourced R&D activities.
- 8.8 Enhancements are made to the tax treatment for CSA payment in respect of section 14C claim with effect from YA 2018 as follows:
 - (a) 100% deduction on CSA payment without the need to exclude expenditure not tax-deductible under section 15 of the ITA; and
 - (b) Removal of the “related to trade” condition.An overview of the R&D tax deduction for CSA payments in respect of R&D projects undertaken under the CSA with effect from YA 2018, is provided in Chart C.
- 8.9 Please refer to Annex D for further details on the quantum of qualifying expenditure eligible for deduction under the different scenarios.

Chart A: Normal R&D Projects



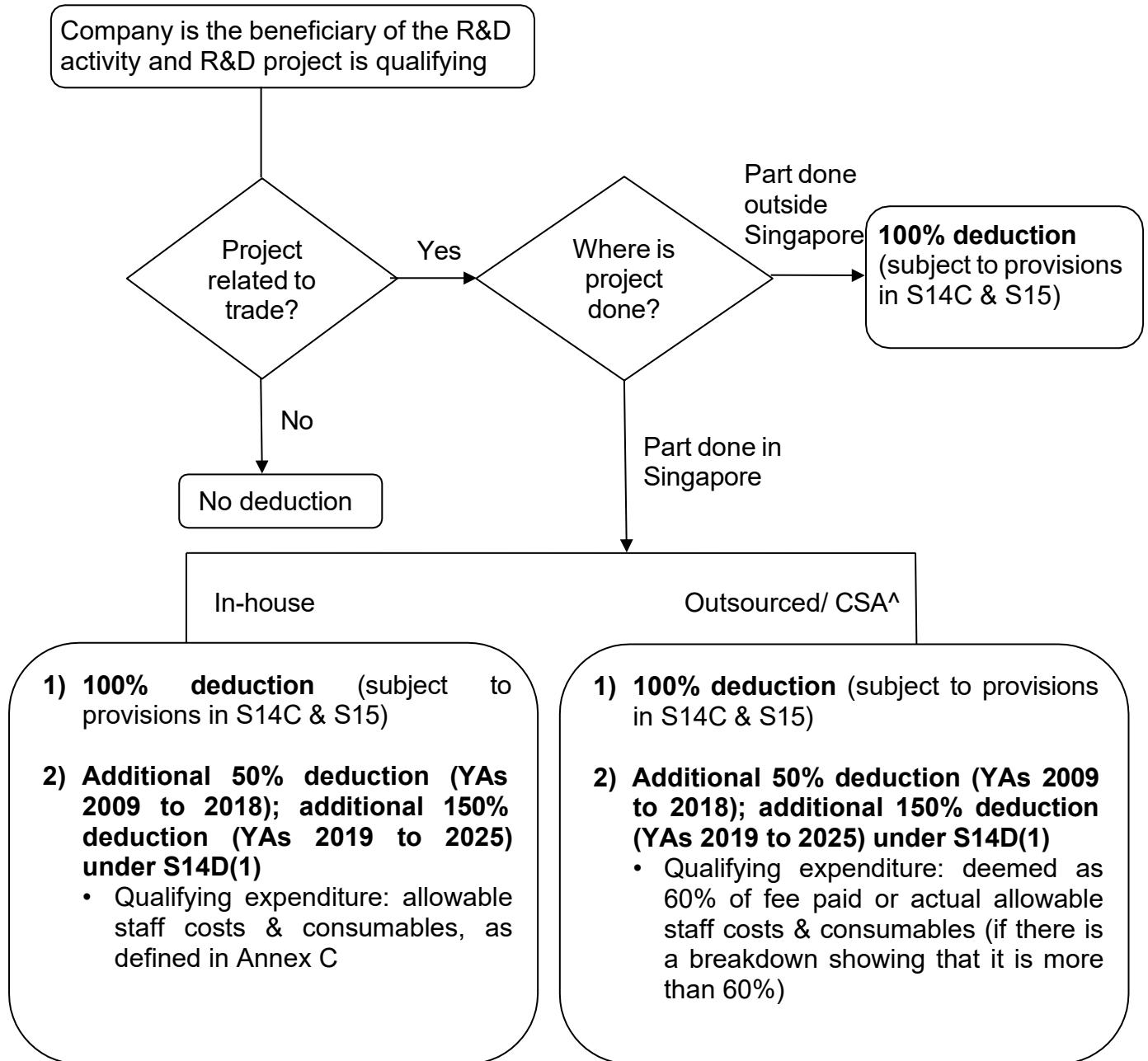
* For YAs 2009 to 2025 (both YAs inclusive), this includes R&D activities done in Singapore that are unrelated to a taxpayer's existing trade or business.

[^] For CSA payment made with effect from YA 2018, please refer to Chart C.

For PIC deduction under section 14D(2), please refer to the e-Tax Guide on PIC.

Chart B: Mixed R&D Projects*

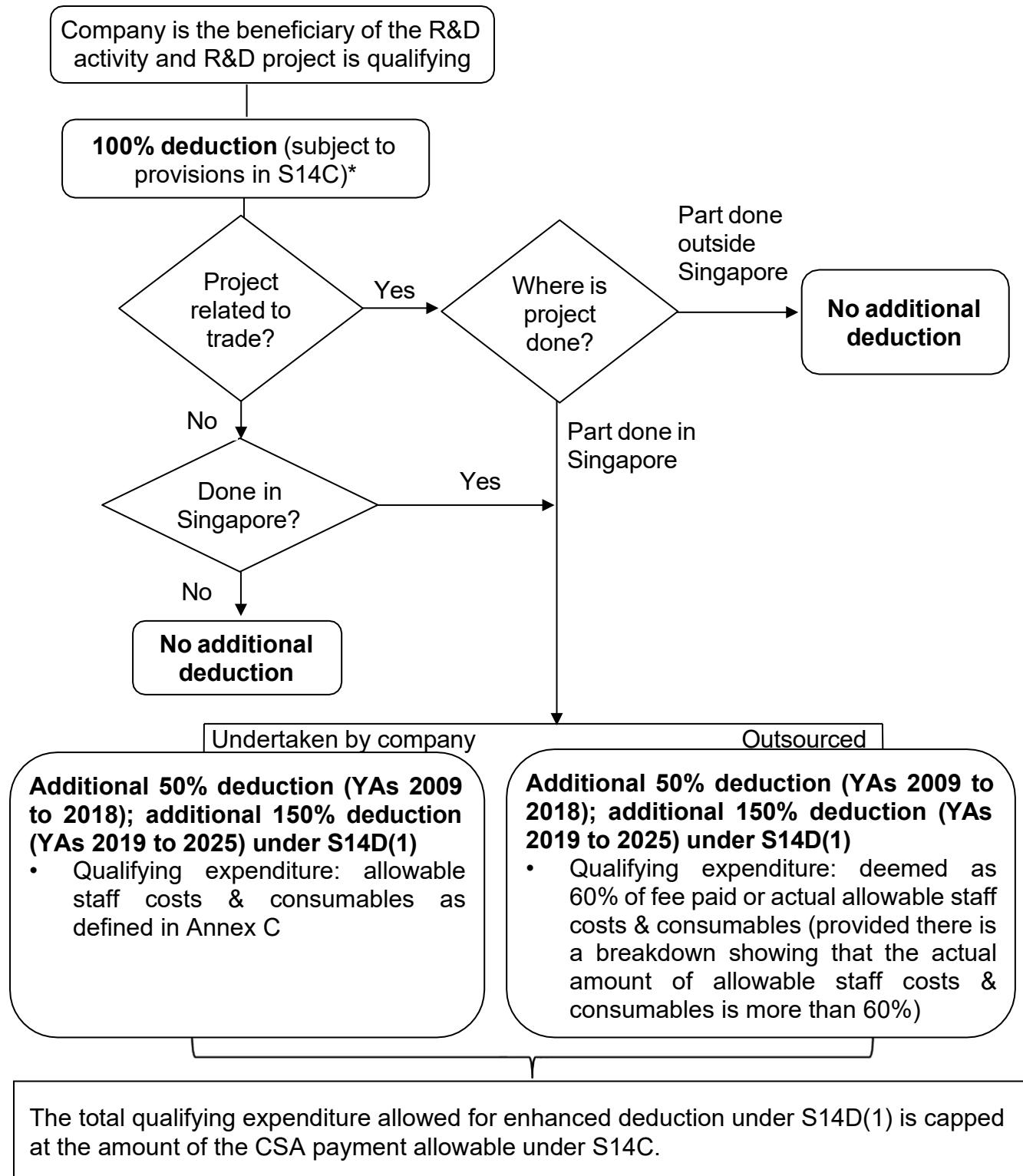
* Refer to R&D projects undertaken partly in Singapore and partly outside Singapore



[^] For CSA payment made with effect from YA 2018, please refer to Chart C.
 For PIC deduction under section 14D(2), please refer to the e-Tax Guide on PIC.

Chart C: R&D Project under CSA[#]

[#] Applicable to CSA payment made with effect from YA 2018



* Please note the removal of “related to trade” condition for section 14C claim. For PIC deduction under section 14D(2), please refer to Annex D.

9. When and how to set off qualifying R&D expenditure?

- 9.1 Generally, the taxpayer can claim deductions on R&D expenditure in the YA relating to the basis period in which the expenditure was incurred. The R&D undertaken may or may not be identifiable to a specific product line and the related income derived may be taxed at concessionary rates. The manner of deduction in various situations is explained in Annex E.

10. Plant and machinery used for R&D purposes

- 10.1 For YAs 2009 to 2025, capital allowances may be claimed by businesses under sections 19 and 19A for cost incurred on the acquisition of equipment in relation to R&D undertaken in Singapore, even if the plant and machinery is not acquired for the purpose of the taxpayer's trade or business.
- 10.2 From YA 2011, prescribed automation equipment acquired for R&D activities conducted in Singapore that are not related to a person's existing trade or business can be written-down in one year. This is in contrast to YAs 2009 and 2010 where capital allowances can only be claimed over the tax working life of the asset or over three years; one year accelerated capital allowance under sections 19A(2) to 19A(10) of the ITA is not permitted even if the asset is a prescribed automated equipment²⁰.

10.3 Set-off of capital allowances

- 10.3.1 The manner of set-off as discussed in Annex E also applies to capital allowances in respect of capital expenditure incurred to acquire plant and machinery used for R&D activities. Examples in Annex F illustrate the manner of set-off of such capital allowances.

10.4 Balancing Adjustments for plant and machinery acquired for use in R&D activities

- 10.4.1 Balancing adjustments (i.e. balancing charges or allowances) are required to be computed on plant and machinery acquired for use in R&D activities under specified disposal/ cessation circumstances listed in section 20 of the ITA.
- 10.4.2 In the case of plant and machinery used by a taxpayer for non-trade related qualifying R&D activities in Singapore, the balancing adjustment is offset against the taxpayer's trade income or treated as income taxable at prevailing corporate tax rate, as the case may be (refer to Annex F for example).

²⁰ Under current rules, an asset which constitutes prescribed automation equipment qualifies for one-year capital allowance claim if it is acquired for the purpose of carrying on a trade or business.

PART C: ADMINISTRATIVE PROCEDURES

11. How do I make a R&D claim?

- 11.1 A taxpayer must make the R&D claim in his Income Tax Return for the relevant YA and submit the completed R&D Claim Form together with his Income Tax Return²¹.
- 11.2 Where a taxpayer has made payments to an R&D organisation to undertake qualifying R&D activities in Singapore on his behalf and is claiming additional deduction under section 14D(1) for expenditure in excess of 60% of any sum payable to the R&D organisation, he is required to support his claim with copies of invoices issued by the R&D organisation for the amount claimed.
- 11.3 A taxpayer is not required to submit any other documentation to support his R&D claim. He should however maintain adequate supporting documentation and provide it to IRAS upon request as part of IRAS' audit or verification process.

12. Documentation

- 12.1 It is critical for a taxpayer to maintain proper documentation of his R&D projects so that he can substantiate his R&D claims to IRAS when requested.
- 12.2 Taxpayers are encouraged to maintain contemporaneous documentation from the start of the R&D project, rather than as an after-event. This is especially important for illustrating how current knowledge was not available at the time of commencement of the R&D project.

Examples of documentation

Objective	<ul style="list-style-type: none">• Specific objective of the R&D project may be stated in the R&D plan or internal records of submission to management for approval of the project.• You must be able to explain how the R&D project goes beyond the current state of technology and knowledge.• Records of enquiries or research you have made on the current state of knowledge and the results of those enquiries e.g. research conducted on industry publications.
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²¹ The R&D Claim Form is available on IRAS Website. The Form must be submitted together with Form C. Taxpayers submitting Form C-S are to retain the completed Form and submit it to IRAS upon request.

Examples of documentation	
	<ul style="list-style-type: none"> Where R&D was carried out to improve a product or process, explanation should be given on why the improvement should not be seen as a minor improvement or upgrade.
Novelty	<ul style="list-style-type: none"> Press statements, marketing materials or website information that states that the product is new to Singapore. Award of a patent resulting from the R&D gives strong evidence of novelty. Literature reviews and feasibility studies that show the product is new.
Technical risk	<ul style="list-style-type: none"> Advice provided by a competent professional that the issue cannot be readily resolved. Explanation of the scientific or technological uncertainty involved and why it could not be readily resolved by a competent professional at the time the R&D activities were carried out. Where taxpayers are applying new uses of existing technologies, explanation should be given on what is the scientific or technological uncertainty that cannot be readily resolved by a competent professional.
SIE study	<ul style="list-style-type: none"> Records of your challenges and why they could not be resolved without undertaking a SIE study. The design of your experimental process. Estimated project timelines and milestones. Records of activities undertaken, including the step-by-step procedures, measurement of outcome and outcome etc. Test results of testing undertaken. Record of steps taken to improve chance of success for subsequent attempts. Records of successful/ unsuccessful attempts and conclusions about whether your potential solution was successful and what this means for your project. Where R&D is outsourced, evidence that the R&D organisation had undertaken a SIE study to address the scientific or technological challenges (may include reports from R&D organisation specifying the activities undertaken by them and the results).

- 12.3 Smaller businesses may not formally document all their steps in an R&D plan. Hence, IRAS is prepared to accept any other supporting documentation²² that the business has to substantiate their claim.

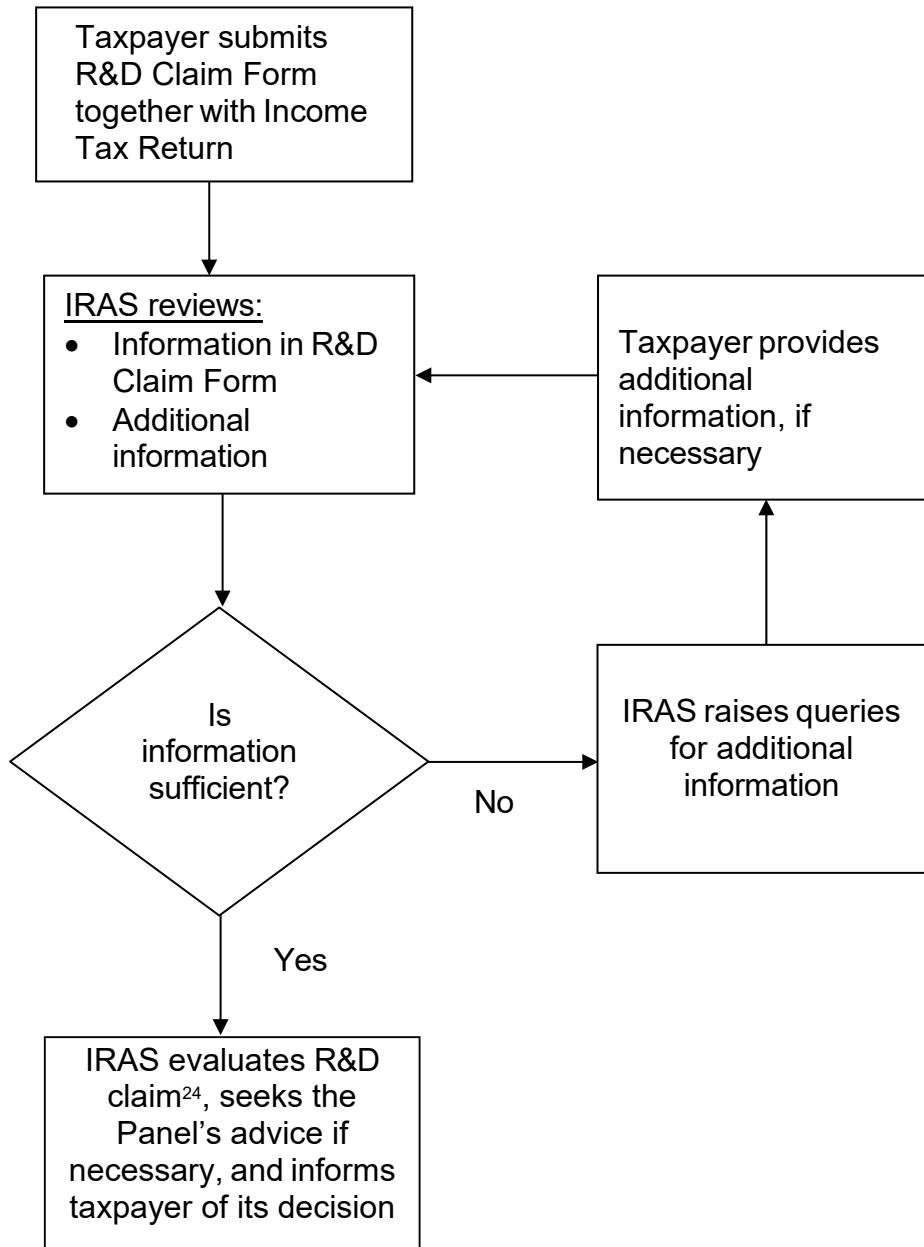
13. What is the review process?

- 13.1 In the first instance, IRAS will evaluate ²³ the R&D claim based on information provided in the R&D Claim Form submitted. Where the information provided is insufficient, IRAS will request the taxpayer to provide additional information or documentation to support the claim.
- 13.2 IRAS has set up a Technical Advisory Panel (“Panel”) to advise IRAS and enhance IRAS’ ability to review R&D applications for the purpose of R&D tax benefits.
- 13.3 The list of the Panel members is available on IRAS Website. All Panel members have provided the necessary undertakings to ensure confidentiality of taxpayers’ information.
- 13.4 R&D cases will be referred to the Panel for review where appropriate, including when:
- (a) The taxpayer requests for the referral specifically; or
 - (b) IRAS rejects that R&D claim after two rounds of review and the taxpayer wishes to pursue the claim.
- 13.5 The Panel reviews the taxpayer’s R&D claim based on the information furnished to IRAS. Where further information is required by the Panel, IRAS liaises with the taxpayer for the requisite information. With the technical advice from the Panel, IRAS makes the final decision on the taxpayer’s R&D claim.

²² Such documentation may include (but are not limited to) working papers, e-mail discussion, test result scripts etc.

²³ Where appropriate, IRAS may consult IPOS International Pte. Ltd. (“IPOS-I”), a wholly-owned subsidiary of the Intellectual Property Office of Singapore (a statutory board under the Ministry of Law), in its review of R&D claims.

13.6 The review process for R&D claim is summarised in the flowchart below:



13.7 Once the evaluation is completed, IRAS will inform the taxpayer of its decision on the R&D claim. If the taxpayer disagrees with the decision, he can object to the assessment in accordance with the objection and appeal process²⁵.

²⁴ Where appropriate, IRAS may consult IPOS International Pte. Ltd. ("IPOS-I"), a wholly-owned subsidiary of the Intellectual Property Office of Singapore (a statutory board under the Ministry of Law), in its review of R&D claims.

²⁵ Please refer to the e-Tax Guide "Corporate Income Tax – Objection and Appeal Process".

14. R&D Assurance Framework

- 14.1 The R&D Assurance Framework (“Framework”) provides taxpayers with upfront certainty on their R&D claims. Subject to the meeting of requirements set by IRAS, taxpayers can enjoy upfront certainty on their R&D claims for up to 3 YAs .
- 14.2 Taxpayers can apply for the Framework if they have:
- (a) good internal evaluation process and supporting documentation to prove that projects included in the R&D claims satisfy the requirements as set out in this e-Tax Guide;
 - (b) at least 5 R&D projects undertaken in-house in Singapore in the YA of application; and
 - (c) qualifying R&D expenditure of at least \$500,000 for these projects in the YA of application.
- 14.3 To apply for the Framework, taxpayers will need to complete and submit the [application for R&D Assurance Framework](#) and a complete list of R&D projects to be included under the Framework. IRAS will select projects to conduct detailed review.
- 14.4 Taxpayers that are interested to apply for the Framework should submit the application form and complete list of R&D projects at least 9 months before the deadline for filing tax return for that YA. If the review of the application is not completed before the tax filing deadline for the respective YA, the taxpayer would need to submit the [completed R&D Form](#) for each project for that YA.
- 14.5 For more information on the Framework including the application form, timeline, evaluation process and frequently asked questions on the Framework, please visit: <https://www.iras.gov.sg>>Taxes>Corporate Income tax>Income & Deductions for Companies>Business Expenses>Examples of Deductible & Non Deductible Business Expenses>Research and development.

15. Contact information

- 15.1 If you wish to seek clarification on the contents of this e-Tax Guide, please contact IRAS at:

Sole-proprietorships/ partnerships	1800 356 8300
Companies	1800 356 8622

16. Updates and amendments

	Date of amendment	Amendments made
1	30 Oct 2014	The amendment reflects the addition of Annex G – Application software R&D projects.
2	22 Jan 2015	The amendment reflects the addition of Annex H –Food & beverages (“F&B”) industry.
3	1 Dec 2017	<p>The main amendments include:</p> <ol style="list-style-type: none"> 1) Deletion of paragraph 4.1(h) due to amendment to the definition of “research & development” from YA 2012. 2) Addition of paragraphs 8.3 to 8.7 on the type of qualifying expenditure for sections 14C and 14D(1) deduction. 3) Insertion of Chart C to provide an overview of the tax deduction for CSA payment with effect from YA 2018. 4) Incorporation in Section 8 of Part B, Annex D and Annex E the relevant enhancements relating to the tax treatment for payment made under R&D CSA. 5) Insertion of a footnote to paragraph 13.1 of the R&D review process. 6) Revision to paragraph 13.4 and insertion of a footnote to the flowchart in paragraph 13.6 of the R&D review process. 7) Insertion of a definition for large and complex R&D projects for the purpose of the pre-claim scheme in paragraph 14.1.
4	29 Jan 2021	<p>The main amendments include:</p> <ol style="list-style-type: none"> 1) Update on the change in additional deduction under section 14D(1) for YAs 2019 to 2025 in paragraphs 8.3, 8.6 and 8.7, Charts A to C, and Annex A paragraph 7. 2) Update on the change in threshold for pre-claim scheme in paragraph 14.1. 3) Update on the expiry of the incentive under section 14E in footnote 1 and Annex A paragraph 8. 4) Insertion of illustrations on the additional deduction for outsourced R&D activities undertaken in Singapore where a Government grant is awarded to fund the R&D in Annex D paragraphs 2.3, 2.4 and 3. 5) Editorial changes for clarity in paragraphs 8.4(a), 8.6, and 12.2.

	Date of amendment	Amendments made
5	8 Jun 2022	<p>The main amendments include:</p> <ol style="list-style-type: none"> 1) Editorial changes to update the previous Section 14D / Section 14DA /Section 37B to Section 14C / Section 14D / Section 37A respectively arising from the renumbering and citation the ITA 1947 (2020 Revised Edition) 2) Updated Part 13.4 clause on referral criteria to Technical Advisory Panel 3) Updated paragraph 14 to replace “Pre-claim Scheme” with “R&D Assurance Framework”

Annex A - Overview of R&D tax measures since Budget 2008

1. In Budget 2008, the Minister for Finance introduced a package of R&D tax measures aimed at encouraging more pervasive R&D in Singapore. These measures included:
 - (a) Liberalisation of R&D tax deduction
 - (b) R&D Tax Allowance scheme (“RDA”); and
 - (c) R&D Incentive for Start-up Enterprise scheme (“RISE”).
2. In Budget 2010, the tax deduction of qualifying R&D expenditure was further enhanced with the introduction of the Productivity and Innovation Credit (“PIC”) Scheme.
3. With the PIC Scheme, the RDA and RISE schemes were phased out with effect from YA 2011. Taxpayers may continue to utilise their RDA granted against their income up to YA2016.
4. In Budgets 2011 and 2012, further enhancements were made to the R&D tax measures via the PIC Scheme. For more information on PIC claims, please refer to the e-Tax Guide on PIC.
5. In Budget 2014, the Minister for Finance decided to extend the following:
 - (a) Additional 50% deduction for qualifying R&D expenditure under section 14D(1), for 10 years till YA 2025;
 - (b) Relaxation of “related to trade” condition, for 10 years till YA 2025; and
 - (c) Further deduction under section 14E, for 5 years till YA 2020.
6. Arising from post-Budget 2017 feedback, the following enhancements were made to the tax treatment for CSA payment in respect of section 14C claim with effect from YA 2018:
 - (a) 100% deduction on CSA payment without the need to exclude expenditure not tax-deductible under section 15 of the ITA; and
 - (b) Removal of the “related to trade” condition.
7. The PIC scheme expired after YA 2018. To support businesses to build their own innovations, the Minister for Finance announced in Budget 2018 that the additional deduction under section 14D(1) will be increased from 50% to 150% for qualifying R&D expenditure (i.e. staff costs and consumables) incurred during the basis period for YAs 2019 to 2025 on qualifying R&D projects undertaken in Singapore.
8. In Budget 2020, the Minister for Finance announced that the incentive under section 14E would lapse after 31 March 2020.

Annex B – Examples of qualifying and non-qualifying R&D

1. Examples of qualifying R&D

1.1 Coating process for bonding wire used in the semiconductor industry

Company A is in the electronics business. While it had been developing silver bonding wire, the industry preferred gold bonding wire, which is expensive. Company A carried out R&D to develop a new silver bonding wire with gold coating, which could be bonded onto different chip surfaces.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1 R&D objective	<p>The R&D objective was to develop a new type of silver bonding wire with an outer gold coating that could be bonded onto different chip surfaces.</p> <p>There was no industrial standard on the optimal gold thickness to coat the bonding silver wire. Also, there was technical uncertainty as the methodology to coat the silver bonding wire was not readily available in the market.</p>	<p>A report on the literature research showed no known ways to have a gold coating layer to be bonded on the chip surfaces used in the semi-conductor industry.</p> <p>Company highlighted 2 recent research publications on the coating process where it was the co-author of the research papers.</p>	<p>The R&D objective was clearly stated (i.e. to create a new product/ process to coat the silver bonding wire to be bonded onto the chip surfaces). In the process, it also acquired new knowledge.</p> <p>The documentation submitted showed a gap between the desired outcome and the state of knowledge and technology at the time of commencement of the R&D, which necessitated a SIE study.</p>

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	<ol style="list-style-type: none"> 1. There was no known methodology on the optimum gold coating layer. 2. A process of systematic experiments had to be undertaken and reiteration effort made to perfect the coating process and for it to be able to be bonded onto the chip surface. 3. It was the first company in Singapore to use this new technology. 	Company referred to the original literature search before it embarked on the R&D project.	While only the novelty or technical risk aspect needs to be satisfied, company satisfied both criteria as the technology produced was a first in Singapore and there was uncertainty which could not be readily resolved by a competent professional based on current knowledge and information.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
3 SIE study	<p>To achieve the R&D objective, the company carried out a range of activities to identify the requirement, characterise the wire, test and finalise the product, including:</p> <ul style="list-style-type: none"> • Researching the optimum gold thickness and evaluating the coating material. • Conducting several investigative studies and testing for the optimum gold thickness coating layer. • Conducting iterative experiments to test and ensure the consistency and reliability of the gold coating layer in high temperature. 	<p>Each iteration study and the test results were documented. This included the time taken for the inner silver to be oxidised with each coating and the improvement made in subsequent iteration.</p> <p>Company produced the 4th and 29th iterations upon request.</p>	<p>Company met the SIE criterion as:</p> <ul style="list-style-type: none"> • There was a proper set of research protocol. • The project was undertaken by a team of competent professionals with R&D track records. • There were a series of systematic experiment carried out to analyse and evaluate the coating process which could not be determined readily (not known or readily deducible).

1.2 Improving the process to develop a lower fat but creamier ice cream product

Company B is a newly start-up company in the food manufacturing industry. The creamy texture of the ice cream is typically achieved by incorporating overrun (trapping of air), through the presence of high fat content. The R&D project was to devise a significantly improved process to develop a creamier ice cream product with lower fat content.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1 R&D objective	<p>To develop a lower fat ice cream product but retain the creamy taste and profile of the ice cream.</p> <p>A potential solution on the fat/ overrun relationship was formulated.</p>	<p>Detailed business plan.</p> <p>Competitive studies on the low fat, creamy ice cream products with focus on the process and alternative fat and saturated fat sources.</p> <p>Literature search found no information on the alternative process (e.g. replacing fat with complex carbohydrates to create the creamier texture).</p>	<p>The newly start-up company had documented a detailed business plan which covered the budget, funding, equipment facilities and marketing to prove the viability of its idea.</p> <p>The company set out to test its potential solution through a series of systematic trials.</p> <p>The R&D objective was clearly stated (i.e. to improve the existing product/ process by finding an improved method to develop a creamier but healthier ice cream product).</p>

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	The project met the technical risk aspect of the R&D definition. There was no information in the public domain on the process to replace the fat with complex carbohydrates to create a creamier ice cream product.	Company referred to the original literature search before it embarked on the R&D project.	Technical risk was involved as there was scientific or technological uncertainty which could not be readily resolved by competent professionals based on current knowledge and information. The company had to carry on substantive SIE works to resolve this uncertainty.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
3 SIE study	<p>To achieve the R&D objective, the company:</p> <ul style="list-style-type: none"> • Experimented on the use of alternative ingredients to replace fat and tested its potential solution. • Discovered that the application method would affect the carbohydrate molecule structure and could not achieve the desired level of aeration (trapping of air). • Consulted peers in the industry but received conflicting opinions on its potential solution. • Conducted further investigation on the application method such as heat, pressure and the mixing speed. • Analysed alternative fat and saturated fat sources and modified the application methods. 	<p>Detailed research design to test the potential solution.</p> <p>Tabulation of the test results on the variables and methods used, including the failed test reports and the observation reports from the failed test.</p> <p>Minutes/ e-mails exchanges with the peers to discuss the processes/ application methods.</p>	<p>It was noted that there were low fat and healthier choices of ice cream in the market.</p> <p>Company had a proper set of research protocol. Company's R&D focused on an improved process to test its potential solution for the fat/ overrun to achieve a creamier product which was not known in the beginning. Hence, a series of investigative and experimental studies were carried out to evaluate the alternative process.</p>

1.3 Designing and constructing an unconventionally shaped reinforced concrete slab (RC slab)²⁶

Company C is in the business of building construction. It undertook construction for a project situated on an inclined site, which was near a high rise building. The geographical situation of the site would impose significant pressure on excavations and make it impossible for a complete RC slab to be used in the basement construction process. The challenge was to develop a construction method that could support the excavations from external forces and pressures and prevent subsidence of the neighbouring property.

The company bore the financial burden of the R&D activities as it absorbed the R&D expenditure incurred, and was able to adopt the new method in a subsequent project.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1 R&D objective	<p>The R&D objective was to develop and evaluate alternative design and construction options for basements as a result of the geographical site situation and the inability to use a complete RC slab in the construction process.</p> <p>There was no industry standard in such construction work. Also, there were technical uncertainties as the construction options considered had not been used by any other developers in the market.</p>	<p>A detailed research report showed the types of RC slab used in various constructions but none was suitable for use in this construction project.</p> <p>Company submitted an article in the industry publication in which an industry expert commended the company as being the first in the industry to adopt this innovative construction method.</p>	<p>The R&D objective was clearly stated (i.e. to create a new construction process). In the process, the company also acquired new knowledge.</p> <p>The documentation submitted showed a gap between the desired outcome and the state of knowledge and technology at the time of commencement of the R&D, which necessitated a SIE study.</p>

²⁶ This was a unique case where the company was the first in Singapore to develop the unconventional RC slab and was able to demonstrate that there was R&D objective as well as SIE study. Not all design engineering solutions will qualify as R&D, unless they meet the three requirements of R&D.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	<p>1. Company's method of supporting the basement excavations by an unconventionally shaped RC slab was the first in Singapore.</p> <p>2. A process of systematic and investigative experiments had to be carried out to develop a construction option that would overcome the challenges of supporting the excavations from external forces and pressures and to prevent subsidence of the neighbouring property.</p>	Company referred to the detailed research report before it embarked on the R&D project.	While only the novelty or technical risk aspect needs to be satisfied, company satisfied both criteria in respect of the new construction method as it was a first in Singapore and there was uncertainty which could not be readily resolved by a competent professional based on current knowledge and information.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
SIE study 3	<p>To achieve the R&D objective, the company carried out the following:</p> <ul style="list-style-type: none"> • A work flow was set up for the experimental work. • Iterative experiments on alternative design and construction options which included the assessment of slab, secant piles and strut designs using finite element analysis to model the pressures and stresses imposed on structural elements by primary roads, those imposed by the neighbouring property, and infrastructure and hydrostatic pressure. <p>The result was the development of a permanent, unconventionally shaped RC slab supported by long struts.</p>	<p>Each iteration study and the test results were documented. This included analysis to model secant pile deflections arising from the presence of the nearby building and hypothetical failed events such as failure of a strut.</p> <p>Upon request, company produced the 5th and 15th analytical results for each of the abovementioned tests carried out for the final design.</p>	<p>Company met the SIE criterion as:</p> <ul style="list-style-type: none"> • There was a proper set of research protocol. • The project was undertaken by a team of professional engineers with R&D track records. • There were a series of systematic experiment carried out to analyse and evaluate the alternative construction options which could not be determined readily (not known or readily deducible).

1.4 Developing a new membrane distillation technique as an alternative to the current water treatment process

Company D is in the business of provision of environmental engineering services. The project aimed to investigate on the potential of membrane distillation as a cheaper alternative desalination technology to various conventional techniques. Together with research institutes, they research on and develop the potential of membrane distillation to be used in the desalination process of seawater.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1 R&D objective	<p>The R&D objective was to investigate on the potential of membrane distillation as a cheaper alternative desalination technology to other established processes, such as reverse osmosis, multi-effect distillation and multistage flashing.</p> <p>The technology was not available in the desalination of seawater.</p>	<p>Research reports on the possibility of applying membrane distillation in the desalination process, which could potentially lead to a cheaper process.</p> <p>The company's recent co-publication on this technology with a local research institute.</p>	<p>The R&D objective was clearly stated (i.e. to create a new process to produce fresh water from seawater). In the process, it also acquired new knowledge.</p> <p>The documentation submitted showed a gap between the desired outcome and the state of knowledge and technology at the time of commencement of the R&D, which necessitated a SIE study.</p>

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	<ol style="list-style-type: none"> 1. The application of membrane distillation technology to sea water was not known at time of research. 2. A process of systematic and investigative experiments had to be undertaken and reiteration effort made to perfect the desalination process for mass production. 3. It was the first company in Singapore to use this new technology. 	Company referred to the original literature search before it embarked on the R&D project.	While only the novelty or technical risk aspect needs to be satisfied, company satisfied both criteria as the technology produced was a first in Singapore and there was uncertainty which could not be readily resolved by a competent professional based on current knowledge and information.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
SIE study 3	<p>To achieve the R&D objective, the company carried out a range of activities:</p> <ul style="list-style-type: none"> Identifying the new materials to be used, the processes to achieve energy efficiency and scalability. Testing the new materials to be used Testing various configurations of membranes. Carrying out lab-scale experiments with simulation model to determine optimal flow patterns/configurations, inter-membrane mass and heat transfer. Carrying out testing in large scale test-bed to assess the degree of scalability, consistency and reliability. 	<p>Each testing was systematically recorded and compared to determine the materials which produced optimal performance relative to cost.</p> <p>Each simulation and the subsequent lab-scale experiment was properly documented and investigated for variances not within the prediction model.</p> <p>Upon request, company produced the 6th and 30th simulation with its results and follow-up actions.</p>	<p>Company met the SIE criterion as:</p> <ul style="list-style-type: none"> There was a proper set of research protocol. The project was undertaken by a team of competent professionals with R&D track records. There were a series of systematic experiment carried out to analyse and evaluate the testing and investigation where results could not be determined readily (not known or readily deducible).

2. Examples of non-qualifying R&D

2.1 Developing an energy efficient air conditioning system for a building

Company E is in the business of providing engineering services. It studied the feasibility of using a variable refrigerant volume (“VRV”) system to replace conventional air-handling unit (“AHU”)/ cooling tower system in a building. The design and development of VRV system (easily controlled and has 25% energy saving capabilities) was novel to the company.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1 R&D objective	The objective was to design and customise a VRV system that was able to reduce energy consumption by 25% compared with the conventional systems.	<p>A report to show that current cooling system was not able to achieve 25% energy savings.</p> <p>Documentation on the intent of the study where the outcome of the project was to customise VRV system to meet or exceed the statutory energy savings requirement.</p>	<p>Information available on public domain showed that VRV system was an existing technology and a 25% energy savings was easily achievable at the time of the R&D commencement.</p> <p>It did not meet the R&D element as the outcome of the study was to measure 25% efficiency gain to meet or exceed the statutory energy savings requirement.</p> <p>Hence, there was no new knowledge acquired and there was no creation or improvement of existing products or processes.</p>

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	<p>The company customised the design and developed the VRV system to obtain optimal usage of refrigerants to enhance energy savings.</p> <p>The quantifying of energy savings involved tests and experiments conducted by engineers/quantity surveyors in the construction field.</p>	Records of project management and internal memos where the fine tuning of installation/ application approaches were carried out by engineers/ quantity surveyors involved in the construction field.	There was no technical risk as it was using existing technology to customise the VRV system and achieving 25% energy savings could be readily resolved by a competent professional in a relevant field. No novelty as this technology had been deployed in Singapore since 1986.
3. SIE study	<p>The company carried out energy stimulations and performed extensive modelling to study the performance of the system and detailed analysis to determine if the 25% energy savings initiative could be achieved.</p>	<p>Issues log throughout the energy stimulations, indicating for each issue how the problem was identified and a description of the testing undertaken to determine that the issue was resolved.</p> <p>Records of the experimental activities including the approaches, the results and analysis on the test stimulations.</p>	There were a series of systematic tests carried out to analyse and achieve the 25% energy efficiency gain. However, such result (e.g. optimum control of refrigerants to increase energy savings) was already known publicly and readily deducible at the time of commencement of the project.

2.2 Developing different grades of concrete

Company F is in the business of manufacture and sale of ready-mixed concrete, including customisation of concrete to customers' requests or specifications. Concrete is graded according to the proportions of cement, sand and granite in the mixture. The different mixes will produce different strengths of concretes, which are used for different purposes.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1 R&D objective	The objective was to produce different grades of concrete-mix for different needs that were not common or easily available in the market.	Communication with the customers on the R&D projects was mainly via e-mails. The e-mails were brief and did not specify the scope of the work. No research was done on the properties of the different concrete mix.	There was insufficient evidence to show that the project was to acquire new knowledge nor to create or improve products or processes.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	<p>The project work was to produce specific grades of concrete as per the customers' specifications.</p> <p>The specific requests arose as customers wanted a customised grade concrete that was not common and available in the market or a better concrete mix than the existing grades of concrete available.</p>	No document was maintained except for the final result analysis of the grade attained.	Though there were experimental works done by the qualified personnel to determine the strength of the concrete, there was no technical risk involved. It was a test to verify the expected outcome. The work carried out was more of a formulation on the proportion of the existing ingredients to achieve the specified grade of concrete. It was more of a product customisation.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
SIE study 3	In the laboratory, the concrete cubes were labelled with information such as the grade of concrete and the number of days the cubes had been cured. These cubes were tested for their toughness and other properties after 28 days before they were crushed and disposed of. Different concrete mixes were produced by the engineers for experimentation and testing. The sample testing was carried out to ensure the quality and grading as specified by the customers were achieved before bulk production.	The company did not keep a log or record sheet to track the activities carried out.	The lack of proper documentation such as record sheet or log to keep track of the work carried out and the result obtained showed that the work did not involve a SIE study. Moreover, the activities were not to test something that was not known or readily deducible. In addition, the product customisation was part and parcel of the routine business activities and hence would fall under the list of excluded R&D activities.

2.3 Commissioning solar-powered golf carts

Company G is in the business of providing engineering services. It noted that the current golf carts in the market were not solar-powered and aimed to introduce the usage of solar-powered golf carts (developed by its parent company) in Singapore.

It was the first company to introduce such golf carts in Singapore. No customisation was required as the golf carts were developed taking into consideration tropical terrain with more cloud and tree canopy coverage, and high humidity. The company was only required to install and commission the carts.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1 R&D objective	The objective was to install and commission the new solar-powered golf carts.	Copy of the manual on the installation and commissioning of the solar-powered golf carts.	The activities were merely an installation project. It was not to acquire new knowledge or to create or improve product and process.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	The novelty of the project was that it was the first company to bring the new golf cart to Singapore.	Brochure and newspaper cutting showing that the company was the first to bring in the new golf cart.	As the first company to bring in a new product to Singapore, the novelty element was satisfied. However, the project did not satisfy the other 2 elements (i.e. objective as well as SIE study) and hence was not a qualifying R&D project.
3. SIE study	There were problems faced in the installation and the first cart was unable to function properly. The engineer had to trouble shoot and was able to resolve the problem after doing some adjustments to the positioning of the solar panel.	No document was maintained on the process of trouble shooting.	<p>The activity carried out by the engineer did not involve a SIE study.</p> <p>The activity was not to test something that was unknown or not readily deducible.</p> <p>The use of solar panels as clean energy was a known technology.</p>

Annex C - Qualifying expenditure under section 14D(1)

1. “Staff costs”

“Staff costs” means any salary, wages and other benefits paid or granted in respect of employment (excluding director’s fees), whether in money or otherwise, to any employee for carrying out R&D activities. The costs include training and certification costs in areas of specialisation relevant to a qualifying R&D project, as well as airfare and living allowances incurred to sponsor an employee to attend relevant overseas training. Where a staff does not engage in qualifying R&D activities on a full time basis, only that part of the staff costs attributable to the time spent by the staff on the qualifying R&D activities is eligible for the additional deduction under section 14D(1).²⁷

2. “Consumables”

“Consumables” means any material or item used in an R&D activity which upon such use, is consumed or transformed in such manner that it is no longer useable in its original form. Examples of consumables are:

- A laboratory chemical which is used up or converted into an unusable product in an R&D process.
- An electronic component that is integrated into a prototype and is no longer available for use for another purpose.

The term does not include items of expenditure such as utilities, rent and other overheads which may be incurred directly or indirectly in connection with the R&D activity.

²⁷ A taxpayer should maintain appropriate documentary evidence to support this (e.g. time sheets). Generally, IRAS is prepared to accept time sheets provided by the taxpayer as documentary proof for the time spent by the staff on the qualifying R&D activities. The taxpayer is not required to submit such documentary evidence unless requested by IRAS.

Annex D - Quantum of qualifying expenditure eligible for deduction under sections 14C and 14D(1)

1. Deduction amount should be net of subsidy

- 1.1 With effect from YA 2011, where a taxpayer receives a grant or subsidy from the Government to fund the qualifying R&D activities, the amount of deduction will be net of the grant or subsidy.
- 1.2 To illustrate, if a taxpayer incurs \$5,000 to employ a researcher to undertake qualifying R&D activities in Singapore but obtains a \$1,000 subsidy from the Government, he is considered to have incurred qualifying R&D expenditure of \$4,000 (\$5,000 net of \$1,000 subsidy) which is eligible for additional deduction.

2. Quantum of qualifying expenditure eligible for additional deduction for outsourced R&D activities undertaken in Singapore

- 2.1 60% of all fees payable to the R&D organisation is deemed to be qualifying R&D expenditure (i.e. staff costs and consumables). This is because where a business contracts with an R&D organisation to undertake qualifying R&D activities on its behalf, it might not be able to identify and determine the amount of qualifying R&D expenditure based on the sums invoiced by the R&D organisation. The following example illustrates this:

Example illustrating the computation of additional deduction – R&D outsourced and conducted in Singapore

For YA 2013, Company A contracts with an R&D organisation to undertake R&D activities in Singapore on its behalf for a fee of \$1M. Assuming that it does not have a breakdown of the expenditure items from the R&D organisation, the amount of additional deduction claimable is determined as follows:

$$\text{Base deduction} = \$1M$$

$$\begin{aligned}\text{Additional tax deduction} &= 50\% \times (60\% \times \$1M) \\ &= \$0.3M\end{aligned}$$

- 2.2 However, where more than 60% of the fees actually relates to qualifying R&D expenditure, the business may claim additional deduction based on such actual qualifying R&D expenditure incurred if it is able to substantiate the claim (see paragraph 11.2 of main e-Tax Guide).
- 2.3 If a Government grant is awarded to specifically fund the qualifying R&D expenditure, the amount of R&D expenditure qualifying for additional deduction shall be computed based on direct identification method as follows:
 - (a) (60% multiply by fees paid to R&D organisation) less grant; or
 - (b) Actual qualifying R&D expenditure (see paragraph 2.2) less grant.

2.4 If a Government grant is awarded to subsidise the fees paid to the R&D organisation ²⁸ in general, the amount of R&D expenditure qualifying for additional deduction shall be computed based on apportionment method as follows:

- (a) 60% multiply by (fees paid to R&D organisation less grant); or
- (b) Actual qualifying R&D expenditure (see paragraph 2.2) less grant attributable to the actual qualifying R&D expenditure. The amount of grant attributable to the actual qualifying R&D expenditure is computed as follows:

$$\frac{\text{Actual qualifying R&D expenditure}}{\text{Fees paid to R&D organisation}} \times \text{Grant}$$

3. Example

Company A has incurred R&D expenditure totalling \$27M in the financial year ended 31 December 2018.

	\$M
R&D performed in-house in Singapore	
- Staff costs: \$17M	
- Consumables: \$2M	
- Other R&D costs: \$1M	20
Payments made to an R&D organisation in Singapore	
- Staff costs: \$3M	
- Consumables: \$1M	
- Other R&D costs: \$1M	5
R&D performed outside Singapore	-
Total R&D expenditure*	27

**The above expenditure in the three categories relate to three separate R&D projects. All projects are related to the company's trade.*

A Government grant of \$4M was received as a subsidy for staff costs incurred in connection with in-house R&D activities.

A Government grant of \$1M was received as a subsidy for staff costs incurred in connection with outsourced R&D activities in Singapore.

²⁸ For in-house R&D activities, the amount of grant attributable to the qualifying R&D expenditure is computed as follows:

$$\frac{\text{Qualifying R&D expenditure}}{\text{Total R&D expenditure}} \times \text{Grant}$$

The total deduction claimable by Company A under sections 14C and 14D(1) in YA 2019 is calculated as follows:

(i) Deduction claimable under section 14C

	\$M
R&D performed in-house in Singapore net of Government grant (\$20M - \$4M)	16
Payment made to an R&D organisation in Singapore net of Government grant (\$5M - \$1M)	4
R&D performed outside Singapore	2
Total deduction claimable under section 14C	<u><u>22</u></u>

(ii) Additional 150% deduction claimable under section 14D(1)

(a) R&D performed in-house in Singapore

	\$M
Staff costs net of Government grant (\$17M - \$4M):	13
Consumables	2
Qualifying R&D expenditure	<u>15</u>
Section 14D(1) deduction (150% x \$15M)	<u><u>22.5</u></u>

(b) Payments made to an R&D organisation in Singapore

	\$M	\$M
Higher of:		
(a) 150% x [(60% x \$5M) - \$1M] = \$3M; or		
(b) Staff costs:	3	
Consumables:	<u>1</u>	
Qualifying R&D Expenditure	<u>4</u>	
150% x (\$4M - \$1M) = \$4.5M		4.5
R&D performed outside Singapore		NIL
Total deduction claimable under section 14D(1)		<u><u>27</u></u>

(iii) Total deduction claimable under sections 14C and 14D(1)
= \$22M + \$27M
= \$49M

4. Quantum of qualifying expenditure eligible for deduction in respect of R&D projects covered by a CSA (with effect from YA 2018)

Example

Company A became a party to a CSA during the basis period for YA 2018. Under the CSA, the R&D activities are partly undertaken by A in Singapore and partly undertaken overseas. The R&D activities are related to Company A's trade. Company A did not make PIC claim for R&D in YA 2016 and YA 2017.

In YA 2018, the amount that Company A is required to bear under the CSA is \$1.5M, of which \$0.5M is payment for the right to become a party to the CSA (i.e. buy-in payment), and \$1.0M is the R&D expenditure that is allocated to and borne by Company A (i.e. CSA payment). Out of the \$1.0M, \$0.7M is for the staff and consumable costs of the overseas R&D.

- 4.1 Assuming that in YA 2018, Company A incurred the following costs in undertaking the part of the R&D activities in Singapore under the CSA (which is reimbursed under the CSA):

	\$M
R&D undertaken in-house	
- Staff costs and consumables	0.8
R&D outsourced to an R&D organisation	
- Fees paid	0.4
Total R&D expenditure	<u><u>1.2</u></u>

The total deduction claimable by Company A under sections 14C, 14D(1) and 14D(2) in YA 2018 is calculated as follows:

(i) Deduction claimable under section 14C

	\$M
Payment under the CSA	1.5
(Less): Buy-in payment	<u>(0.5)</u>
CSA payment allowed under section 14C	<u><u>1.0</u></u>
 Deduction claimable under section 14C (100%)	 <u><u>1.0</u></u>

(ii) Additional 50% deduction claimable under section 14D(1)

	\$M	\$M
R&D undertaken in-house (staff costs and consumables)	0.8	
Add: 60% of fees paid on R&D outsourced to R&D organisation (60% x \$0.4M)	0.24	
		<u><u>1.04</u></u>

	\$M	\$M
Qualifying expenditure (capped at CSA payment allowed under section 14C)		1.0
Deduction claimable under section 14D(1) (50% x \$1.0M) =	<u>0.5</u>	
(iii) Enhanced deduction claimable under section 14D(2) (i.e. PIC claim)		
250% of qualifying expenditure under section 14D(1) (250% x \$1.0M)	2.5	
Add: 300% of overseas staff and consumables (i.e. 300% x \$0.7M) subject to cap	0*	
Deduction claimable under section 14D(2) =	<u>2.5</u>	

*Total is capped at 300% of CSA payment allowed under section 14C less qualifying expenditure allowable under section 14D(1) [i.e. 300% x (\$1.0M - \$1.0M)]

(iv)	Total deduction claimable under sections 14C and 14D(1), and PIC claim	
	= \$1.0M + \$0.5M + \$2.5M	
	= \$4M	

Note: The total qualifying expenditure allowed for enhanced deduction under sections 14D(1) and 14D(2) will always be capped at the amount of the CSA payment allowable under section 14C.

- 4.2 Assuming that in YA 2018, Company A incurred the following costs in undertaking the part of the R&D in Singapore under the CSA (which is reimbursed under the CSA):

	\$M
R&D undertaken in-house	
- Staff costs and consumables	0.4
R&D outsourced to an R&D organisation	
- Fees paid	0.2
Total R&D expenditure	<u><u>0.6</u></u>

The total deduction claimable by Company A under sections 14C, 14D(1) and 14D(2) in YA 2018 is calculated as follows:

- (i) Deduction claimable under section 14C

	\$M
Payment under the CSA	1.5
(Less): Buy-in payment	<u>(0.5)</u>
CSA payment allowed under section 14C	<u><u>1.0</u></u>

	\$M
Deduction claimable under section 14C (100%)	<u>1.0</u>
(ii) Additional 50% deduction claimable under section 14D(1)	
R&D undertaken in-house (staff costs and consumables)	\$M
60% of fees paid on R&D outsourced to R&D organisation (60% x \$0.2M)	0.4
	<u>0.12</u>
	<u>0.52</u>
Qualifying expenditure	0.52*
Deduction claimable under section 14D(1) (50% x \$0.52M)	<u>0.26</u>
(iii) Enhanced deduction claimable under section 14D(2) (i.e. PIC claim)	
250% of qualifying expenditure under section 14D(1) (250% x \$0.52M)	\$M
300% of overseas staff and consumables (i.e. 300% x \$0.7M) subject to cap	1.3
	<u>1.44*</u>
Deduction claimable under section 14D(2)	<u>2.74</u>

* Total is capped at 300% of CSA payment allowed under section 14C less qualifying expenditure allowable under section 14D(1) [i.e. 300% x (\$1.0M - \$0.52M = \$0.48M)]

- (iv) Total deduction claimable under sections 14C and 14D(1), and PIC claim
= \$1.0M + \$0.26M + \$2.74M
= \$4M

Note: The total qualifying expenditure allowed for enhanced deduction under sections 14D(1) and 14D(2) would always be capped at the amount of the CSA payment allowable under section 14C.

- 4.3 Assuming that in YA 2018, Company A did not undertake any R&D in Singapore:

The total deduction claimable by Company A under sections 14C, 14D(1) and 14D(2) in YA 2018 is calculated as follows:

- (i) Deduction claimable under section 14C

	\$M
Payment under the CSA	1.5
(Less): Buy-in payment	<u>(0.5)</u>
CSA payment allowed under section 14C	<u><u>1.0</u></u>
 Deduction claimable under section 14C (100%)	 <u><u>1.0</u></u>

- (ii) Additional 50% deduction claimable under section 14D(1)

Company A is not eligible for section 14D(1) claim as it did not undertake any R&D in Singapore.

- (iii) Enhanced deduction claimable under section 14D(2) (i.e. PIC claim)

	\$M
300% of overseas staff and consumables (i.e. 300% x \$0.7M)	2.1
 Deduction claimable under section 14D(2)	 <u><u>2.1</u></u>

- (iv) Total deduction claimable under section 14C and PIC claim

$$= \$1.0M + \$2.1M$$

$$= \$3.1M$$

Annex E - Manner of set-off for qualifying R&D expenditure

1. As a matter of principle, the matching of expense and revenue should be observed where feasible. Hence the taxpayer needs to establish the purpose or products for which R&D has been undertaken.
2. Paragraphs 3 to 5 set out the set-off rules for different situations. A diagrammatic representation of these rules is in paragraph 6 below.
3. **Qualifying expenditure directly identifiable to specific existing products**

The R&D expenditure should be matched against the specific income streams generated from specific products.

4. **Qualifying expenditure not directly identifiable to specific existing products or are in respect of new products or processes that are related to the existing trade or business**

The expenditure may be treated as common expenses supporting the existing business as a whole and allocated across the different income streams using acceptable bases of allocation that bears a close nexus to the level of R&D activities (e.g. turnover ratio).

5. **Qualifying local expenditure not relating to existing trade or business**

- 5.1 Where a taxpayer concurrently derives income subject to tax at the prevailing corporate tax rate ("normal income") and income subject to tax at concessionary rate(s) ("concessionary income"), tax deduction of any R&D expenditure that is not related to his trade or business, shall first be made against his normal income. Where his normal income cannot sufficiently absorb the R&D expenditure, the excess R&D expenditure is treated as a normal unutilised loss and is available for set-off against his concessionary income in accordance with section 37A of the ITA.
- 5.2 Where a taxpayer derives only concessionary income that is subject to tax at one or more concessionary tax rates, and incurs qualifying local R&D expenditure that is not related to his trade or business, the R&D expenditure is allowed as a deduction against his income from the trade or business that is subject to tax at the highest concessionary tax rate, after applying the following formula:

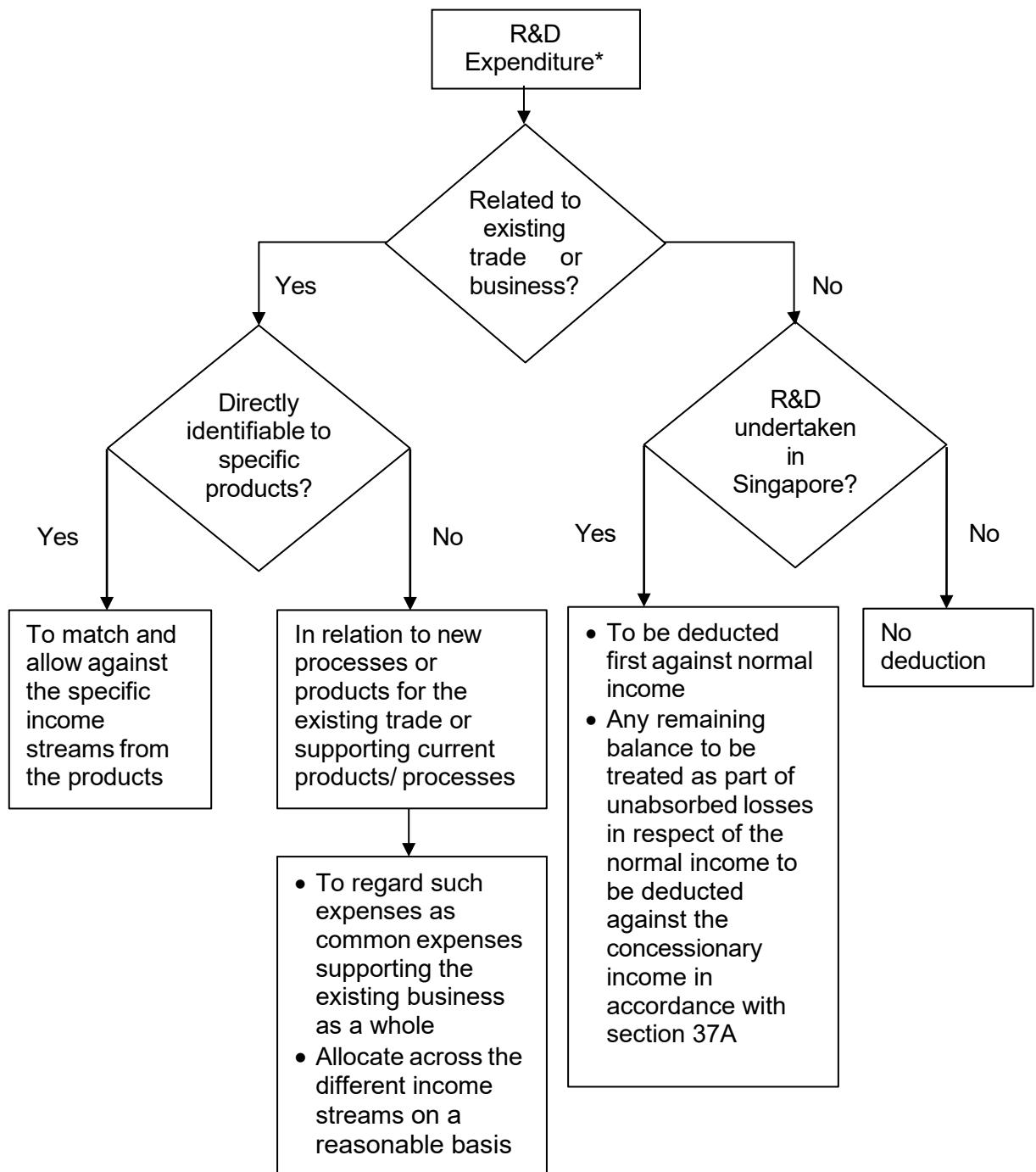
$$A \times \frac{\text{Prevailing Corporate Tax Rate}}{\text{Highest Concessionary Tax Rate}}$$

Where A is the total amount claimable in respect of the non-trade related R&D expenses, under sections 14C and 14D(1) of the ITA.

- 5.3 If the concessionary income subject to tax at the highest concessionary rate is not sufficient to fully absorb the R&D expenditure, the excess qualifying local

R&D expenditure will be treated as part of the unutilised losses for the trade or business from which concessionary income is derived and is available for set-off against any other concessionary income in accordance with section 37A of the ITA.

6. Overview of set-off rules



* For tax treatment for CSA payments with effect from YA 2018, refer to paragraph 7.

7. Qualifying expenditure under a CSA with effect from YA 2018

With effect from YA 2018, the tax treatment for CSA payments in respect of section 14C claim has been enhanced (see paragraph 8.8 of main e-Tax Guide). Paragraphs 3 and 4 above will also apply to CSA payments which are related to taxpayer's existing trade or business.

Annex F - Examples illustrating tax deduction & capital allowance claims

The following examples illustrate the tax deduction and capital allowance claims in respect of qualifying R&D activities that are not related to trade or business carried on by a taxpayer.

Scenario

Company B undertakes in-house R&D activities that are not related to its trade or business.

In the financial year ended 31 December 2012, Company B incurs qualifying R&D expenditure of \$50,000 for R&D conducted in Singapore. In addition, Company B also acquires plant and machinery ("P&M") for use in qualifying R&D activities amounting to \$60,000. The P&M qualifies for a 3-year write-off. Company B also disposes of 2 items of P&M which it acquired for R&D purposes in the previous year. The disposal of the first item of P&M results in a balancing charge of \$5,000, while the disposal of the second item of P&M results in a balancing allowance of \$3,000.

Example 1: Company B derives both normal and concessionary income

Company B's R&D expenditure, capital allowance and balancing adjustments, should be reflected in its income tax computation for YA 2013 as follows:

Tax Computation		YA2013	
		\$'000	\$'000
		17%	10%
Income		300	120
Less: Non-trade related R&D deduction			
- Section 14C	50	-	
- Section 14D(1) (Note 1)	25	-	
- PIC (Section 14D(2)) (Note 2)	125		
Other deductible trade expenses	400	50	
Adjusted Profit/ (Loss)	(300)	70	
Add: Balancing charge on disposal of P&M used for non-trade related R&D	5	-	
Less: Capital allowance			
- P&M used for non-trade related R&D (Note 3)	20	-	
- Trade related P&M	40	-	
- Balancing allowance on disposal of P&M used for non-trade related R&D	3	-	
Section 37A set-off (Note 4)	(358)	70	
Unutilised losses and capital allowances c/f	41	(70)	
	(317)	-	

Note 1: Section 14D(1) deduction = 50% x Qualifying R&D expenditure = 50% x \$50,000 = \$25,000

Note 2: Enhanced deduction under PIC = 250% x \$50,000 = \$125,000

Note 3: Capital allowance for P&M used for non-trade related R&D = \$60,000/3 = \$20,000

Note 4: Section 37A set-off = \$70,000 x 10%/17% = \$41,000

Example 2: Company B derives only concessionary income

Company B's R&D expenditure, capital allowance and balancing adjustments should be reflected in its income tax computation for YA 2013 as follows:

Tax Computation		YA 2013		
		\$'000	\$'000	\$'000
		<u>17%</u>	<u>10%</u>	<u>5%</u>
Income		-	300	120
Less:	Non-trade related R&D deductions			
	- Section 14C (Note 1)	-	85	-
	- Section 14D (1) (Note 2)	-	42.5	-
	- PIC (Section 14D(2)) (Note 3)	-	212.5	-
	Other deductible trade expenses	-	400	50
Adjusted Profit/ (Loss)		-	(440)	70
Add:	Balancing charge on disposal of P&M used for non-trade related R&D	5	-	-
Less:	Capital allowances			
	- P&M used for non-trade related R&D (Note 4)	-	34	-
	- Trade related P&M	-	40	-
	- Balancing allowance on disposal of P&M used for non-trade related R&D (Note 5)	-	5.1	-
		5	(519.1)	70
Section 37A set-off (Note 6)		(5)	43.5	(70)
Unutilised losses and capital allowances c/f		-	(475.6)	-

Note 1: Non-trade related R&D expenses = \$50,000.

R&D expenses regrossed by applying the formula:

$$A \times (\text{Prevailing Corporate Tax Rate}/\text{Highest Concessionary Tax Rate}) \\ = \$50,000 \times 17\%/10\% = \$85,000.$$

Note 2: 50% x qualifying R&D expenditure = 50% x \$85,000 = \$42,500.

Note 3: 250% x qualifying R&D expenditure = 250% x \$85,000 = \$212,500

Note 4: Capital allowance regrossed by applying the formula:

$$B \times (\text{Prevailing Corporate Tax Rate}/\text{Highest Concessionary Tax Rate}) \\ = \$20,000 \times 17\%/10\% = \$34,000.$$

Note 5: Balancing allowance regrossed by applying the formula:

$$B \times (\text{Prevailing Corporate Tax Rate}/\text{Highest Concessionary Tax Rate}) \\ = \$3,000 \times 17\%/10\% = \$5,100.$$

Note 6: Normal income: \$5,000 x 17%/10% = \$8,500

Concessionary income taxed at 5%: \$70,000 x 5%/10% = \$35,000

Total section 37A set-off = \$8,500 + \$35,000 = \$43,500

Annex G - Application software R&D projects

This Annex should be read together with the main body of the e-Tax Guide. Its focus is on application software R&D projects and aims to let taxpayers know the types of information that should be provided to IRAS.

1. Background

1.1 A project is a qualifying R&D project if it passes the three requirements:

Three R&D requirements
(1) Clear objective for undertaking the project
(2) Novelty or technical risk
(3) SIE ²⁹ study in the field of science or technology

- 1.2 Application software is often called “productivity programme” because it enables users to carry out their specific tasks more efficiently and effectively. Some examples of application software are accounting software, word processing software, customer relationship management (“CRM”) software and trading platform software etc.
- 1.3 Generally, IRAS has to request for more information on application software R&D claims. This annex highlights the key types of information that IRAS is looking for.

2. Why does IRAS seek information on application software projects?

- 2.1 IRAS typically requests for information on application software projects for the following reasons:
- Taxpayers have provided substantive information on the commercial objectives but did not provide sufficient information on the scientific or technological objectives of the software project (i.e. the scientific and technological challenges that they seek to overcome). The risks frequently presented by taxpayers (such as schedule risks, unclear user requirements, inappropriate staffing, lack of documents on earlier systems etc.) are not scientific or technological uncertainties.
 - Taxpayers do not submit sufficient information on the SIE studies in the field of science or technology they conducted for the application software projects.

²⁹ Systematic, investigative and experimental

- Taxpayers assume that the entire application software development project is a qualifying R&D project without adequate explanation. There may be many components that constitute an application software and some of which are standard components that are commonly used in the IT industry (e.g. inventory management, standard imaging, and authentication modules). IRAS will require more information to understand the basis for not taking out these standard components in the R&D claims.
 - Taxpayers assume that the complexity of the integration works in an application software project will qualify as R&D activity. While IRAS acknowledges that application software integration is often resource intensive and by no means an easy task, taxpayers need to explain clearly how the integration works meet the three R&D requirements.
 - Taxpayers assume that engaging a software firm to participate in the project means any problem that cannot be readily resolved by on-site staff (own staff and/or that of the professional firm) will meet the second R&D requirement i.e. technical risk. Since technical risk refers to specific scientific or technological uncertainty existing in the projects that cannot be readily resolved by competent IT professionals, IRAS will need more information on the scope of engagement with the software firm and its areas of specialisation and experience in dealing with the particular technical problem to ascertain the technical risk.
- 2.2 Paragraphs 3 to 6 below explain the information a taxpayer should provide for each of the three R&D requirements when submitting R&D claims for his application software projects. Each application software R&D project, however, will be assessed as a whole, i.e. whether it passes all the three R&D requirements.
- ### **3. Objective**
- 3.1 The objective of an R&D undertaking sets out the scientific or technological challenges that need to be overcome. Application software projects are usually undertaken by taxpayers for commercial objectives (e.g. to improve in-house productivity, better serve customers or create new channels to reach out to potential customers etc.). Commercial objectives are generally not the same as the R&D objective. Generally, in submitting the R&D claims, the taxpayer should provide an R&D objective which will include a well formulated outcome which the taxpayer seeks to achieve and an explanation of the scientific or technological challenges in the project e.g. there is no known solution to achieve the outcome or the existing solution is inadequate or inefficient.

Example 1	Enhance existing e-booking software - What should be discussed in the R&D objective
	<p>Company J enhances its electronic booking software to include advanced functionalities such as instant cash rebate and reward redemption connected to third party merchants. This is to improve customer relationship and loyalty.</p> <p><i>There are technologies available to develop the instant cash rebate and reward redemption functionalities connected to the third party merchants. For the R&D objective, Company J should set out the limitations of existing technologies to develop the functionalities and the outcome it seeks to achieve.</i></p>
Example 2	Develop a new education software - What should be discussed in the R&D objective
	<p>Company K develops a novel application that is able to take in and mark student's step by step workings in higher level mathematical equations and provides suggested answers. The current product in the market could only process multiple choice questions and there is no tailored answer given to the student's workings and answers.</p> <p><i>As part of the R&D objective, the company should explain the gap between the desired outcome and the state of knowledge and technology at the time of the commencement of the R&D project. In this example, the gap is the limitation of the current technologies to analyse the unstructured manners of the answers given the variety of ways that the students could provide the answers. It therefore necessitates SIE studies to develop the novel product.</i></p>

Tips
<p>The answers to the following questions should be clear in your claims:</p> <ul style="list-style-type: none"> • What is the outcome that the project seeks to achieve? • What is the scientific or technological challenge identified in the field of science or technology that requires a solution? • Whether existing method to resolve the challenge exists and if so, why are they not adequate?

4. Novelty

- 4.1 Some taxpayers claim that their application software projects are first of its kind in Singapore because they are developed to accomplish a specific and defined set of functions for their business. A project will not meet the novelty requirement if the application performs similar functions as those which already exist in the Singapore market or if it involves only minor or routine

changes or simply brings the knowledge of the taxpayer in line with current knowledge or capability.

Example 3	Develop a new biometric authentication software that meets the novelty requirement
	<p>Company L develops a biometric authentication software specifically catered to its industry. Company L claims that the biometric authentication software developed is novel at that juncture.</p> <p><i>The technology to develop the biometric authentication software is readily available and has been used across many industries. Security is paramount to Company L. For the biometric authentication software, Company L has developed a novel technique which significantly reduces the false acceptance rate (the ratio of number of false acceptance to number of identification attempts) by two order of magnitude. The technique developed will meet the novelty requirement as the performance surpasses the industry norm at that juncture.</i></p>

Example 4	Develop an e-reward redemption software that does not meet the novelty requirement
	<p>In order to retain the customers in its travelling business, Company M develops an application providing instant reward redemption from third party merchants. It claims that this is the “first of its kind” in the travel industry.</p> <p><i>The platform of instant reward redemption from third party merchants exists in a number of industries in Singapore. The adoption of a similar platform with minor changes to the program will not meet the novelty requirement for the purpose of the R&D tax measures.</i></p>

- 4.2 An application software project, such as a new trading platform, may have many sub-functions, components and interfaces (“functionalities”). Where the new functionalities form the core³⁰ of the application software, IRAS may treat the entire software project as meeting the novelty requirement. The entire software project may qualify as R&D, subject to meeting the other R&D qualifying requirements (i.e. R&D objective and SIE).
- 4.3 Taxpayer may undertake software application projects that aim to accomplish specific task to meet specific gaps in the market. The novelty requirement is satisfied if the taxpayer is able to show that there is no effective solution to resolve the problem before the commencement of the R&D project. The project may qualify as R&D project, subject to meeting the other R&D qualifying requirements (i.e. R&D objective and SIE).

³⁰ The core refers to the significantly substantial and key component of the entire application software. E.g. if the design, development and implementation of a platform with a high processing power is the significantly substantial and key component of the entire project (i.e. “core engine”), the peripheral functionalities developed to run the core engine, without which the core engine cannot function, will also form part of the core engine.

Example 5	Develop a new visualisation software that meets the novelty requirement
	<p>Company N creates a new visualisation software that allows users to create and view 3D models alongside Google Street View. This involves developing a novel technique to seamlessly synchronise the model and imagery of the scenes with high accuracy. Company N receives an innovative technology award for its unique integration technique to bring forth a seamless visualisation software.</p> <p><i>Although the project involves integration of existing technologies, it meets the novelty requirement as the technique used for integration has not been carried out before and is first of its kind.</i></p>
Example 6	Develop a new monitoring software that meets the novelty requirement
	<p>Company P develops a novel software to analyse the gestural cues of swimmers in distress. The software will significantly improve the monitoring of the swimmers in the swimming pool to prevent drowning and is first of its kind in Singapore.</p> <p><i>While there are existing algorithms to translate gestural cues of humans on land, there is very limited work in the understanding and the analysis of human behaviour in water. The development of an algorithm to translate the spectrum of swimmer's behavior in distress into an application will meet the novelty requirement.</i></p>
Tips	
<p>Are the following documents, where applicable, available to demonstrate the project is novel?</p> <ul style="list-style-type: none"> • Literature searches, market scanning reports or other contemporaneous documents before the start of the project showing that the functionalities of the proposed software application are not available in Singapore. • Documentation containing an analysis of the pros and cons, both in features and in technical implementations that differentiates your proposed application software from the competitors. • Reasons why available software applications in Singapore do not resolve the problem and necessitate R&D to find an efficient and effective solution. 	

5. Technical risk

- 5.1 Risks such as schedule overrun, budget overrun, undesirable performance (e.g. slow retrieval of information) and maintenance that is more complex than originally anticipated are common project management risks, and will not be considered technical risks.
- 5.2 Technical risk refers to specific scientific or technological uncertainty existing in the projects that cannot be readily resolved by competent IT professionals.

Example 7	Develop an integrated payment platform that meets the technical risk requirement
	<p>Company Q's R&D objective is to develop an integrated payment platform for mobile application developers to easily monetise their digital goods and services within their applications. The existing solution to connect to the payment service providers available to the mobile application developers is inefficient. The company aims to develop a flexible platform with one connection point for the mobile application developers together with a unique secured fingerprint mechanism.</p> <p><i>It is technically challenging to develop an application software that can concurrently handle more than ten payment options, where each payment option has its own limitation and restriction, as some of these limitations and restrictions are incompatible with each other. The platform cannot be integrated using routine methodologies and hence SIE works are required to develop a technique to overcome the incompatibility of the various payment options and make them interoperate seamlessly as an integrated payment platform.</i></p>

Example 8	Improve existing database management that does not meet the technical risk requirement
	<p>Company R experiences slow retrieval of information in its CRM software application. The root cause is due to poor indexing of the database. Company R undertakes re-indexing of the database to address the slow retrieval of information. There is no new indexing method developed. Company R claims that these activities are R&D.</p> <p><i>There is no technical risk as there is no scientific or technological uncertainty. The technical issue can readily be resolved by an experienced database administrator ("DBA") through proper indexing of the database, using existing indexing methods.</i></p>

- 5.3 Where the taxpayer outsource the application software works to software firms, it is important for the taxpayer to find out from the software firms how the functionalities are developed. The taxpayer has to identify the novelty or the technological uncertainties and the SIE studies performed by the software firms for the purpose of claiming software R&D. The beneficial ownership of

the technology developed by the software firm must accrue to the taxpayer for him to enjoy the R&D tax benefits.

- 5.4 Large scale application software projects³¹ typically involve the development of many functionalities (i.e. sub-functions, components and interfaces). Technological or scientific uncertainties may affect only certain parts of the software project and so only those parts of the project may be considered for R&D tax measures. However, where the taxpayer is able to demonstrate that the scientific or technological uncertainties relate to the core³² functionalities developed for the software project, the entire project may qualify as R&D, subject to meeting the other R&D qualifying requirements (i.e. R&D objective and SIE).

Example 9	Develop large scale proprietary trading platform that meets the technical risk requirement
<p>Company S develops a proprietary financial derivative trading platform with significant improvement in the speed and accuracy of its decision making.</p> <p>The differentiating factor between the proprietary financial derivative trading transaction platform and that of others is the ability to process more parameters within a shorter time. The improved methodology allows the platform to process more than ten parameters and reach an accurate decision in less than one minute with no change to the hardware platform. This involves scientific and technological uncertainty as existing technologies could only enable the processing of a few parameters each time and the processing would take much longer.</p> <p><i>Since the improved methodology relates to the core functionalities of the proprietary trading platform, the entire project could be a qualifying R&D project.</i></p>	

Example 10	Part(s) of a large scale patient management software that meets the technical risk requirement
<p>Company T develops a patient portal for a hospital. In developing the portal, the company has to develop many functions. Most of the functions such as data accessibility, notification, registration, scheduling, image storage and retrieval, user authentication, etc. are standard functions. These functions are common and readily available in the market.</p> <p>However, there is a part of the portal project that entails SIE and technical risk – the development of a new indexing technique on the document management module. This new indexing technique will have the ability to recognise unstructured documents and documents with mixed languages.</p>	

³¹ Large scale application software project refers to an application software with a higher number of functionalities (i.e. sub-functions, components and interfaces) in the application software. The development of these functionalities can generally be identified within the project.

³² Please refer to footnote 31.

Example 10	Part(s) of a large scale patient management software that meets the technical risk requirement
	<p>Current technology is not able to achieve a high level of accuracy in the classification of unstructured documents.</p> <p><i>Only the activities undertaken to develop the indexing technique component will qualify as R&D. The development of other standard functionalities for the portal will not qualify as R&D as they do not satisfy the three R&D requirements.</i></p>

- 5.5 Where software development projects include only a few components that are tightly coupled and function as a whole, they are usually evaluated as a whole project as it is not feasible to evaluate components or parts of the project separately.

Example 11	Develop new monitoring application software that meets the technical risk requirement
	<p>Company U develops an activity monitoring application software to provide for early warning for detection of different types of chemical contaminants in water. This is based on analysis of fish group behavior. As such software and technology does not exist at the time of the research undertaking, the project involves scientific or technological uncertainties.</p> <p><i>The project requires the development of an extraction technique with a high level of accuracy from the database of fish behavior collected. As these components in the project are highly interrelated and could not function independently, the project is evaluated as a whole.</i></p>

Tips
<ul style="list-style-type: none"> • Recap and elaborate on the specific technological or scientific uncertainties identified. • Are the following documents, where applicable, available to demonstrate that there is technical risk? • Literature searches, market scanning reports or other contemporaneous documents before the start of the project showing that the technical uncertainties cannot be readily resolved by a competent IT professional. • Documentation of the processes undertaken to find the potential solution to resolve the technical risk. • Depending on whether the R&D project is successful: <ul style="list-style-type: none"> ◦ Documentation to record why the works could not successfully overcome the technological or scientific problems identified and what is the new knowledge gained from the failure.

Tips

- Description of the solution developed and how and where it is applied.

6. SIE in the field of science or technology

- 6.1 Typically, all software application development involves “systematic” study in the field of science or technology as they usually involve structured processes on the following:
- Decision on the foundational tools to be used (e.g. programming language, architecture framework, database, customisation of off-the-shelf package or custom-build or mix etc.).
 - Requirements specification, system design, coding, unit testing, systems testing, user acceptance testing, load testing etc.
- 6.2 “Investigative” and “experimental” activities are carried out to discover and test out potential solutions to the scientific or technological problems identified. Activities that are performed merely to confirm something works as it is designed and intended to be or that is already known or to demonstrate a known fact are not investigative or experimental in nature.
- 6.3 It is a common mistake to regard all software testing activities such as unit testing, system testing, user acceptance testing, load testing etc. as SIE works for R&D tax measures. Testing works that are carried out to validate that the software is programmed as it is designed to be or to confirm that the coding of the software has been correctly carried out are not SIE works for R&D tax measures. These testing activities are not directed at resolving the technical or scientific challenges through a series of investigative and experimental works to find a process or method or to develop an alternative solution.

Example 12	Develop an e-learning platform that meets the SIE study in the field of science or technology
	<p>Company V develops an e-learning platform. There is a series of investigative experiments carried out to develop a method that could intelligently assess the correctness of students' unstructured working steps and pinpoint the mistakes made.</p> <p><i>Investigative works are carried out to explore all possible symbols and ways in which a student could present his workings with minimal restrictions. Experiments are then carried out to test the accuracy and reliability of the method developed to detect, interpret and analyse the students' inputs and determine causes and types of mistakes made by student based on the unstructured answers.</i></p>

Tips

The answers to the following questions should be clear in your claims:

- How is the proposed solution or new method conceptualised?
- What are the proposed steps undertaken by the IT professional to resolve the scientific or technological challenges and how these challenges are resolved?
- Identification of the limitations of the existing technologies and how the gap is closed from the SIE studies?

7. Examples of qualifying application software projects

7.1 Some examples of qualifying application software projects are:

- ✓ Creating a new data encryption method in business application software that is more secured and yet requires less computing resources to encrypt and decrypt. The encryption method developed can meet the performance criteria that the prevailing method cannot achieve (e.g. in terms of its security level, speed of encryption and decryption, computing resources required to execute the encryption and decryption tasks etc.).
- ✓ Creating a robust speech-to-text application with a self-learning capability that provides for fast adaptation to a new speaker. With a few trials involving a new speaker reading a few standardised speeches, the software is able to recognize and capture the speaking rate, pitch range and other parameters of the speaker and provide almost perfect text of what the speaker said.
- ✓ Creating a new compression application software that achieves a higher compression ratio, faster decompression and without loss of accuracy during the process of compression and decompression, when compared to other products in the market.

- 7.2 The table below provides a detailed example³³ of a qualifying R&D project, showing the documentation records to substantiate the R&D claim and how the R&D principles are applied.

Develop a proprietary trading platform for financial derivatives

Company W is in the financial services sector with an in-house R&D IT team. It embarked on a project to significantly improve the speed and accuracy of the decision making process of its trading platform.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1 R&D objective	The R&D objective was to significantly improve the performance of a trading platform. Given that the market is moving quickly and the large volume of trades, the existing trading platform was unable to provide timely and useful information to the users of the systems to assist them to trade. There was also no such platform available in the market that could dynamically adapt to the specific trading parameters of the company.	<p>The plans of the in-house R&D project team to develop a new trading platform.</p> <p>Description of the desired speed, accuracy and reliability of the information.</p> <p>Feasibility study of the various offerings of trading platforms available for sale or licensing in the market (including overseas markets).</p> <p>An analysis of a range of alternatives which are benchmarked against its desired output.</p>	<p>Company has an in-house R&D IT team to develop the proprietary trading platform.</p> <p>The company had done the due diligence to confirm that it was unable to procure a trading platform that met its requirements from the market.</p> <p>Further analysis indicated that there were a few ways that could potentially meet the desired output, but the team was unable to state with certainty which was the best approach.</p>

³³ The example is of general nature and there may exist variations to the example that could lead to a different conclusion.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	<ul style="list-style-type: none"> The in-house R&D team engaged an IT consultant to advise on the technical feasibility of the proposed requirements. The IT consultants worked out a number of options and narrowed down to 3 potential solutions. However, there remains uncertainty over the accuracy, reliability and speed of the output for each of the potential solutions. Experiment on a wide range of realistic and synthetic scenarios. Initial trials were unsatisfactory as performance improvement was marginal. Further investigative works were done to analyse the sub-optimal performance and to identify the reasons for the occurrence of the instability at certain scenarios. 	<p>Results of the test runs showing the iterative development, weaknesses that were identified, testing and practical improvement on each successive tests to the algorithm.</p> <p>Contacts details with the external IT consultants.</p>	<p>While only the novelty or technical risk requirement needs to be satisfied, company satisfied both requirements.</p> <p>The company provided contemporaneous records to prove that there was technological uncertainty which could not be readily resolved by a competent IT professional at the commencement of the project.</p> <p>It met the novelty requirement as there was no such engine available that catered to the specific proprietary financial derivative trading requirement of the company.</p>

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
3. SIE study	<p>The development involved researches into the following areas:</p> <ul style="list-style-type: none"> • Lightweight architecture supporting the execution of the high-speed data • Identify the various parameters and patterns for the algorithmic trading which was unique to the company's decision making process • Computations and rules framework • Time critical query processing • Smart ways to filter input data • Speed and reliability of the execution • Real time intelligence • Database management 	<p>Documentation of the modelling methods and parameters used.</p> <p>Design documentation for the algorithm and the studies undertaken on merits of other algorithms and the conclusion reached.</p>	<p>Based on the document records, there was evidence of a systematic approach to close the gap between the desired outcome and the state of knowledge and technology to develop the system to support the company's trading needs.</p>

8. Examples of non-qualifying application software projects

8.1 Some examples of non-qualifying application software projects are:

- ✗ An adaption or customisation of functions of commercially available software into a customised business application (e.g. defining number of users, setting access privileges, using the rule-based engine to build business rules etc.). These activities typically do not resolve any scientific or technological uncertainties.
- ✗ The maintenance of existing software and debugging activities. These activities are minor and routine changes to existing software or techniques and typically do not resolve any scientific or technological uncertainties.
- ✗ The conduct of studies to select the software offered by different vendors. These activities are part of routine due diligence that a business conducts when choosing software options and are not targeted at resolving any scientific or technological uncertainty.

- 8.2 The table below provides a detailed example³⁴ of a non-qualifying R&D project, showing the documentation records provided to substantiate the R&D claim and how the R&D principles are applied.

Develop a business automation software application to automate an established manual procedure in an organisation

Company Y is in the insurance business that sells a number of financial products. It embarked on a project to automate its manual processes.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1 R&D objective	Automate the business processes across the finance, treasury and HR departments to improve productivity.	Project initiation report which stated that there is an urgent need to automate the manual processes due to difficulty in recruiting and retaining suitable staff.	The submission described the commercial reasons to automate the application. It did not state the scientific or technological challenges aspects of the project that necessitated R&D.

³⁴ The example is of general nature and there may exist variations to the example that could lead to a different conclusion.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	<p>Challenges included:</p> <ul style="list-style-type: none"> • Complex programming, including many iterations of programming, debugging and testing until the desired end result was achieved. • Need to achieve seamless interface between the front-end customer touch point/ online portal with backend system. • Need to ensure data security, automatic tracking and high reliability of the application. 	Company merely reiterated the challenges in developing the complex business rules.	<p>Claims merely stated the normal application features. There was no discussion on the technical uncertainty involved.</p> <p>Complex programming was normal development and testing activities that did not involve scientific or technical uncertainty.</p> <p>Company did not highlight any new technique that was developed from the activities carried out in the automation software.</p>
3. SIE study	The development went through many iteration of designs, coding, re-coding and testing due to the complexity of the business rules.	The design and testing documents.	Activities carried out were normal application development life cycles. It was not to find out something that was not known or readily deducible.

Annex H - Food & beverages (F&B") industry

This Annex should be read together with the main body of the e-Tax Guide. It focuses on development of products and processes within the F&B industry. It aims to help taxpayers from this industry to evaluate if the projects undertaken by them qualify for R&D tax incentives. It also assists taxpayers in submitting the relevant information so as to facilitate IRAS review of the application. We have also provided examples to illustrate specific points. Each R&D project, however, will be assessed as a whole, i.e. whether it passes all the R&D requirements.

1. Background

- 1.1 The annex focuses on the following areas as these are the key areas within the F&B industry where R&D are being carried out.

Area	Using science and technology to:
Products	<p>Develop new products or make substantial improvements to one or more of the key characteristics of existing products.</p> <p>Examples of key product characteristics include aroma, taste, texture, nutritional value, calories value, solubility and shelf life.</p>
Processes	<p>Develop new F&B production methods (including food treatments and packaging processes) or make substantial improvements to one or more of its key characteristics of existing production processes.</p> <p>Examples of key process characteristics include improvement in energy efficiency, introduction of new minerals and nutrients, shorten the elapsed time required, maintain look, taste and texture, lengthen the shelf life and minimise food spoilage.</p>

- 1.2 A project is assessed based on the following three requirements and must not fall within the excluded activities listed below.

Three R&D requirements
<ol style="list-style-type: none"> 1. Clear objective for undertaking the project 2. Novelty or technical risk 3. SIE³⁵ study in the field of science or technology

³⁵ Systematic, investigative and experimental

- 1.3 The excluded activities as specified under section 2 of the Income Tax Act 1947 are:

Excluded activities	Examples of the excluded activities
<i>i) Quality control or routine testing of materials, devices or products</i>	<ol style="list-style-type: none"> 1. Quality assurance ("QA") activities such as inspection, testing and monitoring of components including (i) Brix, (ii) carbon dioxide ("CO²") content, (iii) pH levels, and (iv) sensory properties for new packaging and altered formulation of food and beverages before sale. 2. Outsourcing to external laboratory to conduct nutritional analysis. 3. Testing of raw materials from new suppliers. 4. Quality control activities for the purpose of maintaining quality certification system (e.g. ISO9001, HACCP, BRC). 5. Microbiological tests such as testing for pathogens and spoilage organisms to ensure food safety.
<i>ii) Routine modifications or changes to materials, devices, products, processes or production methods</i>	<ol style="list-style-type: none"> 1. Calibrating existing equipment within prescribed parameters to fine-tune the cleaning and sterilisation process for containers used for food and beverages. 2. Calibrating newly installed equipment to optimise production performance. 3. Expanding a product's range of flavour where no technical risk or SIE activities are involved. 4. Creating new recipes with introduction of new flavouring chemicals where no technical risk or SIE activities are involved. 5. Reviewing and updating procedures relating to food hygiene and good manufacturing practices to industry standard.
<i>iii) Cosmetic modifications or stylistic changes to materials, devices, products, processes or production methods</i>	<ol style="list-style-type: none"> 1. Creating packaging where the only innovation lies in the aesthetic design or presentation. 2. Introducing new product theme by adding colouring additives and having different size and shape of the food product.

2. Objective

- 2.1 For the purpose of claiming R&D tax incentives, just stating the commercial objectives for the project is inadequate. Commercial objectives (e.g. create new products to meet demand for healthier food) are generally not the same as the R&D objective. In submitting the R&D claims, taxpayer should provide the R&D

objective which he seeks to achieve and an explanation of the scientific or technological challenges in the project e.g. explain the inadequacies of the existing solution and the desired outcome.

2.2 Examples where the R&D objective is met:

Example 1	Develop organic lactobacilli-added feed to improve quality and yield of chickens
	<p>Company AA aims to develop organic lactobacilli-added feed which changes the rearing process of chickens to be free of antibiotics and artificial growth hormones. With the new feed, the chickens are expected to be less susceptible to diseases. It should also enhance the quality of the chicken meat by having lower fat and cholesterol content. The excretion of the organic lactobacilli-fed chickens should also have reduced ammonia and hydrogen sulphide content.</p> <p><i>Taxpayer has met the R&D objective as it has clearly stated in the claim form:</i></p> <ol style="list-style-type: none"> 1. <i>R&D objective of developing and introducing lactobacilli-added feed for rearing chickens and to achieve the desired outcome.</i> 2. <i>Current state of antibiotics and artificial growth hormones in existing rearing process including the growth rate, rate of pre-mature death, elapsed time required for the traces of antibiotics and growth hormones to reach acceptable level.</i> 3. <i>There is technical uncertainty on whether the lactobacillus feed would enhance the growth, immune system and intestinal micro flora balance in the chickens and control the growth of potential pathogenic bacteria.</i>

Example 2	Extract flavouring ingredient from fruits and plants with reduced sodium
	<p>Company AB aims to extract a flavouring ingredient from fruits and plants to boost and enhance the flavour while allowing for sodium reduction in applications like soup-mix or soup-based products. The company reports that it is able to replace the 0.2% of the monosodium glutamate used in existing flavouring products. This will reduce the sodium content of soup-based applications by 25%.</p> <p><i>Taxpayer has met the R&D objective as it has clearly stated in the claim form:</i></p> <ol style="list-style-type: none"> 1. <i>R&D objective of extracting a new flavouring ingredient to boost flavour, reduce sodium content while not affecting taste, texture, cost and shelf life of products that use this ingredient.</i> 2. <i>Technical challenges faced in identifying the best source and extracting a flavour that meets all the desired criteria of boosting flavour, reducing sodium content etc.</i>

Example 2	Extract flavouring ingredient from fruits and plants with reduced sodium
3. <i>Details of the scientific experiments carried out on the extractions of flavouring components in fruits and plants, analytical tests on the savoury taste and sodium content of the soup-based applications that used the new ingredient.</i>	

Example 3	Develop a fortification process for concentrated herbal soup paste
<p>Company AC aims to develop a fortification process to add essential micronutrients i.e. vitamins and minerals to the concentrated herbal soup paste. It studies the technologies best suited to achieve the desired properties while ensuring that there is no interaction between the fortificants and the herbal ingredients and that the vitamins & minerals will not be destroyed by the cooking process.</p> <p><i>Taxpayer has met the R&D objective as it has clearly stated in the claim form:</i></p> <ol style="list-style-type: none"> <i>1. R&D objective of developing the micronutrient fortification process to enhance the concentrated herbal soup paste.</i> <i>2. Current state of fortification process and the practical problems faced in using it with Chinese herbs.</i> <i>3. The existing technical challenges on the development of new combinations of fortificants with the herbal ingredients. The added fortificants have to attain the chemical stability, appearance, nutritional value, taste and aroma of the original Chinese herbal soup throughout the process.</i> 	

2.3 Example where the R&D objective is not met:

Example 4	Improve roasting of the barbequed Bak Kwa
<p>Company AD aims to improve the crispiness and tenderness of the individually packed barbequed Bak Kwa by making various adjustments to the duration and the temperature used during the roasting process.</p> <p><i>In the claim form, taxpayer states that the project involves changing the duration and temperature of the roasting process. There is no scientific or technical uncertainty. It is a mere routine modification to improve the roasting process. Hence, the R&D objective requirement is not met.</i></p>	

2.4 Example where the R&D objective is not clearly stated:

Example 5	Develop carbonated sparkling coconut drink
<p>Company AE aims to develop carbonated sparkling coconut drink by using real coconut water with same nutrition and health benefits as fresh coconuts, but without preservatives.</p>	

Example 5	Develop carbonated sparkling coconut drink
<p><i>In the claim form, taxpayer does not state the current state of technology for storing coconut drink and the scientific or technical challenges faced. Hence, it does not meet the R&D objective requirement.</i></p>	
<p><i>To show that the R&D objective requirement is met, taxpayer will need to elaborate:</i></p>	
<ol style="list-style-type: none"><i>1. Current state of storing coconut drink and its limitation.</i><i>2. Scientific or technical challenges (such as acidity, degradation of taste, colour and aroma of real coconut water, how to retain its nutrients and health benefits within the expected shelf life) that need to be overcome when processing the natural coconut water into carbonated sparkling drink.</i>	

Tips

The answers to the following questions should be clear in your claims:

- What is the desired outcome of the project?
- What is the scientific or technological challenge identified for which a new solution is needed?

3. Novelty

- 3.1 Some taxpayers claim that their R&D projects are first of its kind in Singapore because they are the first to develop and launch the new product or process in the industry.
- 3.2 For a product or process to qualify as novel, it must not have existed in Singapore before or there are substantial improvements to one or more of the key characteristics in the existing product or process in Singapore. If the developed product or process is a minor or routine enhancement to the existing product or process, it will not satisfy the novelty requirement. Similarly, if the developed product or process simply brings the knowledge of the taxpayer in line with the current knowledge or capability, it will also not satisfy the novelty requirement.
- 3.3 New product or process that is imported from overseas will not qualify as R&D activity unless the other two R&D requirements are met.

3.4 New products and processes are generally products and processes that have substantial differences in their characteristics from those previously developed by the taxpayers or those existing in the market. Examples of characteristics include:

i. Products

- Physical such as texture, shape, size, colour, viscosity and surface condition.
- Chemical such as chemical stability, nutritional value, moisture content, functional contents, pH level and chemical contaminants.
- Biological (including microbiological) such as biological stability, changes or interactions among the micro-organisms present in food (e.g. bacteria, mould, pathogens and spoilage organisms).
- Sensory such as aroma, savoury taste (salty, sweet, bitter, sour, umami³⁶).

ii. Processes

- Effectiveness and efficiency in reducing waste and energy (including green initiatives), lowering production costs, shortening elapsed time.
- Biological and chemical interactions between ingredients (including packaging materials) and their response to various methods both before and after the process.
- Effectiveness in preventing contamination or spoilage.
- Effectiveness in preserving food flavour and freshness.
- Ease of transportation and storage.

3.5 Examples where the novelty requirement is met:

Examples	IRAS' evaluation
1. To research into enzymes that can be incorporated into a new food product that will stimulate metabolism and burn more fat within the human body. This product allows people with mobility disability to reap some of the benefits of physical exercise.	The project satisfies the novelty requirement. There is key technology break-through as the taxpayer is the first to identify the enzyme that mimic or enhance the effect of physical exercise.

³⁶ Umami (a loanword from Japanese) can be described as a pleasant “brothy or meaty” taste with a long lasting, mouth watering and coating sensation over the tongue.

Examples	IRAS' evaluation
<p>2. To develop a new and unique processing system for the instant noodles and spaghetti industry which achieve the following:</p> <ul style="list-style-type: none"> ▪ replace oil fried with air fried, ▪ do away with the need for separate flavour sachets by directly infusing the noodles with the flavours, and ▪ maintain the taste and texture of the instant noodles and spaghetti as well as their shelf life. 	<p>The project satisfies the novelty requirement. It is a process which is new to Singapore.</p> <p>The taxpayer has also registered a patent for this new processing technology.</p>
<p>3. To develop a packaging can for soup and beverage with a built-in self-heating component. The heating process is activated by pressing a button.</p> <p>The button is a device that when activated generates a localised hot spot on the surface of the chemical that starts the oxidation process and creates heat. The oxidation process can heat the soup or beverages to about fifty degrees Celsius in two minutes</p>	<p>The project satisfies the novelty requirement. There is key technology break-through as it is the first system to precisely control the oxidation process to safely and efficiently generate heat energy.</p> <p>A patent is registered for this self-heating packaging technology.</p>

3.6 Examples where the novelty requirement is not met:

Examples	IRAS' evaluation
<p>1. To develop aluminium beverage cans with textured surfaces using customisable patterns to distinguish the brand, improve marketability and gain a competitive advantage.</p> <p>Taxpayer claims that it is first of its kind in Singapore and satisfies the novelty requirement.</p>	<p>The innovative design is essentially making aesthetics change to the packaging.</p> <p>It is cosmetic modifications or stylistic changes and does not meet the novelty requirement.</p>

Examples	IRAS' evaluation
<p>2. To develop fruity taste cheese with grape flavours using food additives available in the market.</p>	<p>There is cheese with apple and orange flavours in the market. The process of using a new flavour additive and the reaction of the raw materials with the new flavour additive is known.</p> <p>Thus, the introduction of new flavour (grape) cheese will not be viewed as new product. It does not satisfy the novelty requirement.</p> <p>In addition, it is a routine modification to the existing formulation.</p>

Tips
<p>Are the following documents available to demonstrate the project is novel?</p> <ul style="list-style-type: none"> • Literature researches, market scanning reports or other contemporaneous documents before the start of the project showing that the product/ knowledge is not readily available in Singapore; or that there are substantial differences between the existing products and the product that is being developed. • Documentation containing an analysis of the pros and cons, both in features and in technical implementations that differentiates the proposed formulations, processing or packaging methods from those of competitors.

4. Technical risk

- 4.1 Risks such as schedule overrun, budget overrun, and longer time period to adhere to food regulations and requirements will not be considered as technical risks.
- 4.2 Technical risk refers to specific scientific or technological uncertainty existing in the project that cannot be readily resolved by a competent professional in the F&B industry. Competent professional may include food scientist, food technologist, process engineer and production engineer.
- 4.3 It is observed that where a product or process is novel in the F&B industry, there will usually be technical risk in developing the product or process. If the product or process is not novel, the technical risk usually arises from the fact that information on product or process development in this industry is a closely guarded secret. Such information is generally not reasonably available to an outside party.

- 4.4 Where a product development or improvement to existing product involves only the modification to the carrier (from water soluble to oil soluble and vice versa), changes in form (from liquid to powder or vice versa) or changes in intensity (i.e. concentration level), there is generally little or no technical risk involved. The biological, physical and chemical interactions among the ingredients arising from such modifications are usually publicly known and can be readily resolved by a competent food scientist or technologist. However, if such modifications result in acquisition of new knowledge (i.e. beyond existing base know-how or technology), then the technical risk requirement is met.
- 4.5 Where the project is outsourced to another firm, it is important for the taxpayer to find out from the outsourced firm how the product/ process is developed. The taxpayer has to identify the novelty or the scientific or technological uncertainties and the SIE studies performed by the outsourced firm for the purpose of claiming R&D tax benefits. The beneficial ownership of the product and/ or technology developed by the outsourced firm must accrue to the taxpayer for him to enjoy the R&D tax benefits.
- 4.6 Examples where the technical risk requirement is met:

Examples	IRAS' evaluation
1. To create a new flavour from the extracts of certain plant that can be used in high temperature food processing without losing its aroma.	<p>The project involves technical risk as existing extract from other plant loses the aroma when processed at high temperature.</p> <p>The food technologists need to identify and extract specific essence that contain the aroma and can withstand high temperature processing.</p>

Examples	IRAS' evaluation
<p>2. To develop a new preservation method by exploring the anti-microbial functionalities in protective bacterial culture and natural antimicrobials. The aims are to maintain the vitamins and nutrients in fruits, keeping the taste and texture unchanged, and making them less prone to spoilage without the use of chemical preservatives.</p> <p>Extensive experimentations are carried out on the protective bacterial culture as well as natural antimicrobials to develop a new process to preserve fruits. Fruits treated by this process can stay fresh for 10 more days and are more resistant to spoilage.</p>	<p>Finding suitable bacterial cultures necessitate research in molecular biology as well as interdisciplinary co-operation and this yields new knowledge.</p>
<p>3. To develop bio-based polyethylene films derived from sugarcane for beverage packaging.</p> <p>The bio-based low density polyethylene ("LDPE") has the same physical and chemical properties as the traditional fossil fuel derived polyethylene, yet bio-degradable.</p>	<p>The project involves technical risk as the development of new bio-based polyethylene films entails risk factors such as interactions, solubility and bio-degradable thresholds.</p> <p>These issues cannot be readily resolved by a competent food scientist or technologist.</p>

4.7 Examples where the technical risk requirement is not met:

Examples	IRAS' evaluation
<p>1. To work with a global ingredient company to explore ways to extend shelf life with existing natural preservatives and develop products according to customers' specifications.</p> <p>The technology is available in the public domain. The customisation requires reformulation of recipes and adaptation of the production process.</p>	<p>The domain knowledge is readily available in the market.</p> <p>The project involves routine formulation and redevelopment where the technical problems can be readily resolved by a competent food scientist or technologist.</p>

Examples	IRAS' evaluation
<p>2. To increase production efficiency, a company changes the production of its product from a batch process to a continuous operation. To ensure consistent quality for the product in the new continuous operation, test runs are done.</p> <p>The risks are inability to achieve the targeted production efficiency and consistency in quality for the product.</p>	<p>There is no scientific or technological uncertainty involved in the upgrading of the production facility.</p> <p>Issues relating to production efficiency and consistency in quality for the products can be readily resolved by an experienced quality control staff.</p>

Tips
<p>Are the following documents available to demonstrate that there is technical risk?</p> <ul style="list-style-type: none"> • Literature searches, market scanning reports or other contemporaneous documents before the start of the project showing that the technical uncertainties cannot be readily resolved by a competent food scientist or technologist. • Documentation of the processes undertaken to find the potential solution to the technical risks. • Depending on whether the R&D project is successful: <ul style="list-style-type: none"> ◦ Documentation to record why the works could not successfully overcome the technological or scientific problems identified and what is the new knowledge gained from the failure. ◦ Description of the solution developed and how and where it is applied.

5. SIE in the field of science or technology

- 5.1 Qualifying R&D project involves “systematic, investigative and experimental” activities to discover something not publicly known or readily deducible in the field of food science or technology.
- 5.2 Testing activities that are performed by random trial and error and in an unstructured manner will not qualify as SIE activities.
- 5.3 Activities that relate to commissioning of new equipment, calibrating, fine-tuning, or optimising of processes or production systems may involve testing, recording and evaluating the results. These activities are usually standard processes directed towards confirming results within expected range. Hence these activities do not qualify as SIE activities.
- 5.4 Examples where the SIE requirement is met:

Examples	IRAS' evaluation
<p>1. To develop new seasoning application methods known as "3D seasoning" to overcome the shortcomings in the traditional syrup coating application method.</p> <p>The shortcomings are:</p> <ul style="list-style-type: none"> • Unable to apply coating on fried products as water and oil will create resistance. • Sugar affects the viscosity and hygroscopic of finished products. • Low heat resistance causing stickiness and shorter shelf life. <p>The new method enables syrup application on all types of snack bases, reduce the level of sweetness and ensure healthier food for consumers.</p>	<p>SIE requirement is met as the following activities are carried out:</p> <ol style="list-style-type: none"> Investigative study to search and experiment different materials that may be substituted for the sugar syrup. Series of testing and experiments to get the seasoning with similar viscosity as sugar syrup. Tests using different snack bases to determine the ideal drying temperature to maintain the crispy texture of the snacks and the shelf life. Iterative tests and the results are documented to show the level of heat resistance in various snack applications.
<p>2. To increase the umami or savoury taste in foods without adding sodium, a SIE study is conducted on the yeast extracts to develop ingredients that improve the mouth feel in applications like sauces and processed meat.</p>	<p>SIE requirement is satisfied as the following activities are carried out:</p> <ol style="list-style-type: none"> Investigative study to research and experiment on yeast extract and formulating it with varied ingredients. Series of tests and experiments to develop the ingredients for improved taste and reduced sodium. Iterative tests and the results are documented on the study of the sodium content and its applications on varied sauces and processed meat.
<p>3. To develop cost effective technology to manage poultry waste and to produce good quality and disease-free composts for vegetable farming and/ or biogas production.</p>	<p>Taxpayer satisfies the SIE requirement as it carries out systematic, investigative and experimental process in various stages from prototypes of waste plant to the study and tests on the biogas output, odour emission and</p>

Examples	IRAS' evaluation
<p>Company adopts an innovative waste treatment technology for recovery and recycling of resources which achieve:</p> <ul style="list-style-type: none"> • Anaerobic digestion of poultry waste. • Biogas produced to generate electricity for farm. • Treatment of waste effluent water to reduce odour emission. • Composts generated in the treatment process to be used as fertilisers for vegetable farms. 	<p>quality of composts for agricultural use.</p> <p>The knowledge on waste technology is proprietary and not publicly available.</p>

5.5 Examples where the SIE requirement is not met:

Examples	IRAS' evaluation
<p>1. To develop new product mixtures (i) Lite Salt and (ii) Salt Balance by blending sodium chloride and potassium chloride with (i) 50% and (ii) 25% less sodium than regular salt.</p>	<p>The activities carried out are merely routine product modifications and launches of differentiated products with varied sodium content.</p>
<p>2. Company carries a series of tests to determine the optimum parameters, e.g. temperature, duration and ratio of tea powder to water, in the brewing process with the installation of a new tea brewing machine for production line.</p>	<p>The tests are merely to ascertain the specifics of the production process with the addition of the new tea brewing machine.</p> <p>It does not satisfy the SIE requirement.</p>
<p>3. To develop a beverage pouch with air-filled handle and newly designed fun straw. The company has to work out the different positioning and sizes of the handles and straws.</p> <p>Trials and testing are done to achieve the optimum positioning of the handles before the final pouch design is determined.</p>	<p>Taxpayer does not satisfy the SIE requirement as the trials on the different positioning and sizing of the handle and straw are merely to find the optimum positioning.</p> <p>There is no systematic, investigative and experimental process carried out in the study of food science or technology.</p>

Tips

The answers to the following questions should be clear in your claims:

- How is the proposed solution or new method conceptualised?
- What are the proposed steps undertaken by the food scientist or technologist to resolve the scientific or technological challenges and how these challenges are resolved?
- Do you have the relevant documents to demonstrate the iterative steps carried out, the learnings from each step and how the steps contribute to the final outcome?
- What are the limitations of the existing technologies and how the gap is closed from the SIE studies?

6. Examples of qualifying projects

- 6.1 The table below provides detailed examples³⁷ of qualifying R&D projects including the documentation records to substantiate the R&D claim and how the R&D principles are applied.

6.2 Product and process - develop food additive which solubilise natural flavour or colour oils into clear beverages

Company AF is in the business of manufacturing and selling food chemicals and additives to F&B firms.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1 R&D objective	<p>To develop a new food additive that would solubilise natural flavour and not cause the beverages to become cloudy.</p> <p>Based on existing technology, beverages flavoured or coloured with existing additive would turn cloudy.</p>	<p>The plans of the in-house R&D project team.</p> <p>Feasibility study of the project and analysis of a range of alternatives which were benchmarked against its desired output.</p>	<p>The R&D objective was clearly stated (i.e. to improve the existing products/ process by finding a solution to rectify the defect in existing technology). It also involved acquisition of new knowledge.</p>

³⁷ The example is of general nature and there may exist variations to the example that could lead to a different conclusion.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	<p>There was only one company in the global market that produced food additives that solubilised natural flavour and colour oils into clear beverages. The knowledge was proprietary and unavailable in the public domain.</p> <p>The company studied and explored the beverage pH, emulsion formulation, order of addition and other potential variables. The end product was highly useful for solubilising natural flavour and colour oils into clear beverages.</p>	<p>There was no existing literature describing the method.</p> <p>Experimentation documents of failed trial tests showed that there were technical challenges to be resolved.</p>	Technical risk was involved as there was scientific or technological uncertainty which could not be readily resolved by a competent food scientist or technologist at the commencement of the project.
3 SIE Study	<p>The R&D team carried out a series of structured and iterative tests to explore the beverage pH, emulsion formulation, order of addition and other potential variables. These included selection of the appropriate catalyst, reaction process and purification method. A pilot-testing was also carried out to test the interaction of the various variables.</p>	<p>Results of the experiments showing the iterative development, weaknesses that were identified, testing and practical improvement on each successive tests.</p>	Based on the document records, there was evidence of a systematic approach to close the gap between the desired outcome and the state of knowledge and technology to develop the end product.

6.3 Process – develop a low carbon hydraulic water-driven commercial urban vertical farm for vegetables

Company AG is in the business of vegetable farming. It specialises in vertical farming and uses green urban solutions to achieve significant production yield of safe, fresh and delicious vegetables.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1 R&D objective	<p>The farming system applied the urban green technology to achieve:</p> <ul style="list-style-type: none"> • 5 times higher yield in production compared to traditional monolayer farms. • Rotation powered by energy saving hydraulic water-driven system with low carbon • Harness natural sunlight instead of artificial light in the existing vertical farming method. • Low water usage with same recycled water source to power the rotation to irrigate and fertilise the plants. • Low manpower dependency. 	<p>The project plan and the collaborative agreement with the sponsor agency.</p>	<p>The R&D objective was clearly stated (i.e. to create a new farming process). There was new knowledge acquired and creation of a new and innovative method of farming.</p>

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	<p>It is the world's first low carbon hydraulic water- driven vertical system for growing vegetables vertically in the tropics, and which gives significant yield and uses less water, energy and natural resources to achieve a sustainable green high tech farm. The vegetables are grown in A-shaped towers, each of six to nine meters tall. Each tower rotates around the aluminium tower frame at a rate of 1mm per second to ensure uniform distribution of sunlight, air and irrigation for all the plants. The rotation is powered by unique patented water-driven system that uses only 0.5 litres water and consumes only 60W of power for each tower. Water is recycled with very little run-offs.</p> <p>Its output is at least five times more than that of conventional soil-based farming. It can achieve up to 12 crop cycles per year.</p>	<p>Press statements and media news that the company was the first in the world to develop the vertical farming using low carbon, hydraulic water- driven system.</p> <p>The company patented the water pulley system that tapped on the flowing water and gravity to rotate the tiers of growing troughs mounted on an A-shape aluminium frame.</p>	<p>While only the novelty or technical risk requirement had to be satisfied, company satisfied both requirements. There was no such farming system available at the start of the project and there was technological uncertainty which could not be readily resolved by a competent professional based on current knowledge and information.</p>

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
3 SIE study	<p>To achieve the R&D objective, the company:</p> <ul style="list-style-type: none"> • Carried out investigative testing, experiments and reiterations in building up the aluminium tower frame and the water pulley system. • Conducted tests to monitor and determine the optimum flow of the drainage and the rotation of the racks in the tower. • Recorded the different levels of effects of sunlight and water to ensure the vegetables received sufficient sunlight and at the same time nutrients in the water equally. • Carried out further iterations to achieve optimum output by recording the rate of growth, amount of sunlight received, water drainage and the energy consumption of different vegetables. 	<p>Each iteration study and test results were documented. This included analysis of the preliminary failed designs and subsequent modified designs, records of the experimental reports on the rate of growth, yield of different vegetables with different drainage, sunlight exposure and soil compost.</p> <p>Upon request, the company produced the 11th modified design as well as the 15th experimental record with its results and follow-up actions.</p>	<p>Company met the SIE requirement as:</p> <ul style="list-style-type: none"> • There were a series of systematic experiments carried out to analyse and evaluate the testing and investigation where results could not be determined readily. • There was a proper set of research protocol. • The three-year project was undertaken by a team of competent professionals with R&D track records.

6.4 Process - develop greener alternative with sustainability to replace standard beer bottles

Company AH is in the business of beer brewery. With the trend of going green, it undertook a project to launch a new bottling method.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1. R&D objective	To develop an eco-friendly packaging alternative by using compressed recycled paper to replace glass bottle for containment of beer. The bottle was made of paper with the internal lining using plastic. It was recyclable and 100% bio-degradable.	The company submitted the feasibility plan on the paper bottle packaging.	The objective requirement was met as it set to create a new packaging product/ process. It went beyond current conventional packaging and involved a different technology.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2. Novelty/ Technical risk	<p>Information on pulp moulding technology was very limited as it was still relatively new at the start of the project. The company was the first in Singapore to carry out the research on the feasibility of using eco-friendly and sustainable paper bottle packaging.</p> <p>The company had to overcome a number of technical uncertainties to achieve the following R&D objectives and achieved more than 70% reduction in energy in the production process:</p> <ol style="list-style-type: none"> 1. No change in the quality of beer and shelf life. 2. Bottle had to be light yet rigid, strong and ice-bucket-safe for a few hours. 3. No undesirable flavours caused by the packaging. 	<p>Literature study on the paper bottle packaging concept was relatively new worldwide and there was no information in the public domain on the pulp moulding technology. This technology is also proprietary in nature.</p>	<p>While only the novelty or technical risk requirement needs to be satisfied, company satisfied both requirements. There was no such packaging concept available at the start of the project and there was technological uncertainty which could not be readily resolved by a competent professional based on current knowledge and information.</p>

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
3 SIE study	<p>To achieve the R&D objective, the following activities were conducted:</p> <ul style="list-style-type: none"> Structured and iterative processes were conducted to test the different quality and thickness of the pulp, physical mobility stacking check against rough knocks, water resistance level for structural integrity, preservation and the shelf life of the beer in paper bottles. Tests were done to ensure the paper bottles were able to protect the beer against contamination by microbes such as bacteria and impact of light. Tests were conducted to ensure packaging do not contribute any undesirable flavours to the beer. 	<p>Records of the various challenges faced, activities undertaken and how the challenges were resolved including the step-by-step procedures, measurement of outcome and outcome of test results</p> <p>Upon request, the company produced the 5th and 12th analytical results for each of the tests conducted.</p>	<p>Company met the SIE requirement as it was shown the iterative experiments and trials conducted to test the material, structure integrity and the chemical reaction of the beer with the packaging. The results could not be determined readily (not known or readily deducible).</p>

7. Examples on non-qualifying projects

7.1 The table below provides detailed examples³⁸ of non-qualifying R&D project including the documentation records reviewed and the R&D principles applied to explain why the project does not qualify.

7.2 Product and process - develop an authentic premix flour formulation for seafood frying.

Company AJ is in the business of mill graining and manufacturing of flour related products.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1. R&D objective	<p>To develop an authentic premixed flour formulation for frying of seafood such as prawn, squid and fish slice.</p> <p>The company had to achieve the following R&D objectives in their formulation and production process:</p> <ul style="list-style-type: none"> • Light crispy texture. • Golden yellow colour. • Spiky surface pattern. • Thin and good adhesive coating. 	<p>The proposal plan to develop the premix flour formulation.</p> <p>Structured plan and timeline of the project.</p>	<p>The objective was a routine formulation to develop the premixed flour product. It was based on the existing technology and the company was merely changing the concentration of the various components of an existing premix to produce the new mix. Hence, the objective requirement was not met.</p>

³⁸ The example is of general nature and there may exist variations to the example that could lead to a different conclusion.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2 Novelty/ Technical risk	<p>To achieve the R&D objective, the company stated that it faced the following technical risks:</p> <ul style="list-style-type: none"> • New formulation was needed. • Complexities in selecting the right type of flour and ensuring the required properties could be achieved. • Modification of starches that would mix well with the flour. 	<p>Literature study on the types of ingredients and existing know-how formulation of baking powder to create the flour formulation.</p> <p>Evaluation analysis of the commercially premix formulation available in the market.</p>	<p>The novelty requirement was not satisfied as there is readily premixed flour in the market. There was no new technological knowhow acquired from the project.</p> <p>There was no technical risk involved as the issues on ingredient interactions were known to a competent scientist or technologist.</p>
3 SIE study	<p>To achieve the R&D objective, the company carried out the following:</p> <ul style="list-style-type: none"> • Researched the various types of modified starch, baking powder and other ingredients. • Surveyed and evaluated different brands of commercially premixes. • Formulated basic recipes and experimented the various ingredients. 	<p>Records of prototypes developed for the pre-mix formulations to be used for testing and analysis.</p> <p>Documentation of the result analysis to determine whether the R&D objectives have been achieved.</p>	<p>The tests and prototypes developed were part and parcel of taxpayer's routine product development or modifications. It was a non-qualifying R&D project as the know-how and knowledge were publicly available at the commencement of the project.</p>

7.3 Process - revamp the pouches used for the range of baby cereals and smoothies

Company AK makes baby and toddler food including cereal, smoothies, snack and others. Existing products in the market were packed in pouches and cardboard containers.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
1. R&D objective	The R&D objective was to revamp the packaging design on pouches used for baby cereals and smoothies with the new colourful distinctive look and better finish.	The proposal plan to revamp the packaging.	The objective was only to change aesthetic design of the packaging. It was based on the existing technology. Hence, the objective requirement was not met.

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
2 Novelty/ Technical risk	<p>The existing pouch was simple in design and square shaped, hence dull and not eye catching. Comparatively, the new design was innovative as it was first of its kind in Singapore to have pouches in animal shaped with big, bright fonts and childlike drawings such as 'Yummy Apple ' or 'Nice Banana'</p> <p>The colour of the pouches followed the food theme with nutritional information in a clear format, combining necessary details with an eye-catching design. The matt finished colours of the package stand in pointed contrast to the gloss areas that highlight logos and product information.</p>	<p>Market study on the customers' preference, social and spending pattern.</p> <p>Design plan of the food pouches.</p>	<p>The novelty requirement was not satisfied as the change was merely aesthetic. There was no new technological knowhow acquired from the project.</p> <p>The change was cosmetic rather than aimed at improving shelf life, durability or product integrity. It fell under the exclusion activity.</p>

	Extracts of information submitted in taxpayer's R&D application form	Documentation records kept by taxpayer to substantiate upon request	IRAS' evaluation
3 SIE study	<p>To achieve the R&D objective, the company:</p> <ul style="list-style-type: none"> Conducted market research on the consumers' preference. Surveyed and subscribed to market data to study the market trend, preference and social pattern of working family with young kids. Solicited ideas and feedback from target group of customers. Performed statistical analysis and study of the market data collected. 	<p>Structured plan and timeline of the project</p> <p>Statistical data on the finding on customers.</p> <p>Supplier's proposal plan on the design and material to be used for the packaging.</p>	<p>The study was on consumer behaviour and not in the field of science or technology. It was a non-qualifying project.</p>