A return-on-investment approach for public good research investment and partnerships

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Background

To determine where to invest in public good research, the Queensland Government (indeed any government or impact oriented not-for-profit organisation) needs a credible, transparent, and preferably quantitative prioritisation process based on agreed principles. The principles defined here are embedded within return-on-investment thinking.

A cost utility analysis is proposed by which all investment decisions can be objectively appraised using sound principles giving a greater chance of positive outcomes. This approach contrasts with having a simple list of ‘priority research areas’ which can risk being too broad or too narrow, popular but not strategic or impactful, or be an emerging issue likely to be resolved without the need for government intervention.

The scope of this approach could include co-investment in Collaborative Research Centres, ARC Linkage Grants, Advance Queensland grants, collaborative research infrastructure and internal government research beyond that deemed essential research. The needs of the Queensland Government change through time because of opportunities, threats and new technologies. Hence, these principles need to be utilised alongside a current set of more specific needs, for example vaccine development and natural disaster management.

Research, including the application of existing knowledge to a new context or the iterative development of knowledge may take many years. This return-on-investment approach for research investment may be best applied to research that is likely to take 2-10 years for completion. If the research duration is less than 2 years, it may be best completed as a consultancy/contract. If the research is likely to take a longer time than 10 years, or is more fundamental, then it should probably be part of a major research centre or embedded as a priority in a co-funded research institute (5-20 years).

The Queensland Government should support applied research that is likely to deliver outcomes in terms of the things the state values: health, jobs, safety, the environment, equity, a diversified economy, and community resilience. While basic research is important, it generally does not deliver short-term outcomes. The state investment in applied research should occur where there is a clear explanation (model, or theory of change) that shows how the research could deliver outcomes the state values by way of changes in policy, regulation and management.

This return-on-investment approach can be a component of the project evaluation cycle to enable improved models for difficult to estimate criteria like probability of success.

How we often make research investment decisions?

In most quantitative investment allocation processes we invariably have a large number of proposals (grants or projects) and many criteria. These criteria might include various aspects of how likely the proposal is to succeed (quality of team, track record of team, a judgement of experts of the track record), the likely benefits of the proposal (health, environment, equity, climate change etc.) and cost. For example, the Queensland Government has used **The REDS** approach for prioritising investment–aligning with the **decision rules for investment (REDS)** that target impactful R&D for Queensland:

- Real future impact – delivering economic, environmental, and social benefits that are measurable and translate to end-user benefit.
- External commitment – attracting and leveraging funding and resources from collaborators.
- Distinctive angle – targeting comparative advantage and uniqueness.
- Scaling towards critical mass – addressing the global opportunity.

While all these criteria are very logical, what happens in practice is that numbers are then assigned for 5-10 criteria that are then summed. For example, we might consider a proposal and give it scores for ten criteria: climate change, equity, health, biodiversity, project team capability, likelihood of commercialisation, leverage, unique Queensland advantage, cost and potential to scale. This process is much better than an *ad hoc* non-quantitative approach, but suffers from the assumption that all criteria are equal (and if we do weight them, then we need arbitrary weightings for ten criteria). As a result, feasibility and cost, which are as important as net benefit, become far less important (and sometimes ignored). However, logically, a project that is half the cost is twice as good, and a project that has a chance of success of 10 per cent is ten times less valuable than a sure thing, all other factors being equal.

Consequently, we suggest a more rigorous return-on-investment approach.

What are the principles?

The best research is *likely* to *cost-effectively* deliver *outcomes* for Queenslanders in terms of health, jobs, safety, the environment, equity, economic resilience, and others via policy, regulation and management, above and beyond what would otherwise have happened (the *counterfactual*) in a timely fashion. This single sentence encapsulates the four driving principles for research investment in a project that drive the return-on-investment equation:

Benefit above and beyond what would otherwise have happened if we did nothing (B) times the chance the research would NOT have otherwise happened in a timely fashion without investment (P) times the probability of successful implementation of the research (S) divided by cost to the Queensland Government (C).

Or as a mathematical equation: BPS/C

In other words, the four driving principles described above are the parameters of the cost utility equation BPS / C which can be used to rank research investment opportunities. Notably, there are no arbitrary weightings, indeed, logically, each factor is equally important. Each of these parameters, or variables, are described in more detail below.

1. *Benefits (Outcomes)* (***B)*** **–** substantial benefits, are better than small benefits. Benefits are the priorities of government and they should be quantified. For example, the health outcomes of any health research project can be expressed in the improved quality life years it delivers (QALYs), while environmental research projects can be quantified in terms of CO_2 equivalents (climate change) and/or number of species saved (benefits). Some projects deliver on multiple outcomes – to compare benefits across multiple outcomes we will use a trade-off analysis and/or weighted sum. This approach is reflected in the term ***Benefit (B)***. For example, a research project on forestry practices might deliver improved safety and hence 10 QALYs per year and a reduction in terms of 0.1 Gt of CO_2 equivalents, so *B* = $\alpha(10) + (1-\alpha)0.1$ where α is varied to reflect our emphasis on safety, relative to climate change. This is the only time we need an arbitrary weighting in this approach.

2. *Would not otherwise have happened (**P**)* **–** the Queensland Government investment needs to be important, if not essential, to the success or speed of the project. Research that would otherwise have been carried out without Queensland Government investment, or happened too slowly with state support, is not a high priority. This concept is reflected in the term ***above and beyond what would otherwise have happened if we did nothing (P)*** which will often be a probability. For example, if the research project on forestry practices is unique to Queensland and nobody else is working on this topic, then we multiply by 1. But if the same work is being conducted in three other

places, then we might assign a value $P = 0.2$ because we think there is an 80 per cent chance someone else will solve our problem.

3. *Likely* to be successful and deliver impact (***S***) – the research has a high chance of delivering the outcomes. High likelihood research is research that:
   - is likely to be successful (which depends on the research team track record and talent base, facilities etc.)
   - is likely to be implemented (it delivers results where there is a clear model that connects the research results to new policy, regulation and management that can be feasibly implemented)
   - is delivered in time to realise the benefits.

   Hence there are three components to *"Likely"* (often called feasibility or probability of success). In the equation this is **Chance the research delivers that outcome (S)**. For example, if the research project on forestry practices is being carried out by a well-qualified team that has already delivered research that gets implemented, and we can foresee no obvious social or economic impediment to a change in management practices in this sector then, based on past experience, we might estimate S is 0.8.

4. *Cost-effective (**C**)* – cheaper research and research with greater leverage is better. Cost is often ignored or considered a minor factor, but it is very important due to the power of the denominator of the equation, just as important as the outcomes component. Cost should be the cost to the government and calculated using full-cost accounting approaches). In the equation this is **Cost to State Government (C)**.

Ideally these four factors are combined in a single quantitative assessment to determine the return-on-investment from research investment. However, to reduce the options, it is often convenient to have some 'drop-dead' selection process to filter out projects before return-on-investment analysis is implemented.

Examples of 'drop-dead' criteria to quickly select projects unlikely to be investable include:

1. Projects that far exceed existing budgets, resulting in a huge C.
2. Research projects which are soon to be completed by other organisations, resulting in a very low P.
3. Applicants/partners have no expertise in area, a very poor track record, or a substantial skills gap, resulting in a very low S.
4. The project is deemed unlikely to have any impact on decisions, management or policy e.g. below 10 per cent (or $S < 0.1$).
5. Small benefits (B) e.g. in conservation this might mean benefit to a very small area or one relatively unimportant species.

Once projects have been filtered, then the return-on-investment formula can be used to help inform choices around the prioritisation of limited resources.

Notes

1. The estimate of *likelihood of success* is, ideally, the product of three probabilities:
   - the chance that the project is technically feasible (growing potatoes on Mars may be a long shot)
   - the chance the results of the project is socially and economically possible to implement
   - and the chance the project does deliver an advance that is sufficiently profitable and different to be implemented (a new herbicide that is 5 per cent more effective probably won't get manufactured as the gains are negligible).

2. The counterfactual (*what would have happened otherwise*) can be hard to estimate and often we may not be able to estimate this probability. To create a counterfactual of what would happen if we invested nothing in a project requires bold foresight.

3. Would not otherwise have happened may be hard to estimate quantitatively so often be used as part of the "drop-dead" criteria where we ignore projects where Queensland is well behind the cutting-edge of the science.

4. Leverage reduces the *cost to government*, for example if some initial investment leverages a much larger investment from other sources, Queensland does not need to factor in those costs.

This return-on-investment approach for research investment and partnership provide an objective methodology for mitigating bias that often permeates decision-making processes. Cognitive traps include biases related to confirmation, anchoring, narrative, sunk-cost fallacy, loss aversion, status quo, and many more.

More information

How does this methodology differ from existing prioritisation approaches for investing in public good research?

This return-on-investment approach is NOT radically different from existing approaches – it merely attempts to add an element of transparency and quantification of the evidence used to support investment decisions. The methodology takes into account very similar criteria to standard practice, its main innovation is combining them in a logical way.

Return on invested capital (ROIC) – comparing ROIC of an investment with the weighted average cost of capital to determine whether the venture is profitable, and value is created or destroyed (*whole formula*). This approach is more aligned to cost-benefit analysis and works when benefits can be monetised. We are assuming that benefits cannot be turned into money (*e.g*. lives saved or species saved).

Triple bottom line – considering broader outcomes related to economic, social, and environmental benefit (*outcomes*). This lens is accommodated in the Benefit and Cost components of the equation.

Environmental, social and governance (ESG) priorities – adhering to ESG criteria by investment in sustainable and responsible initiatives. Accommodated in the Benefit component and likelihood of success.

Sustainable development goals – recognising that investments in economic growth and prosperity must be balanced with developing a more equal society that protects the environment. Accommodated in the Benefit component or some drop-dead criteria. For example, if a proposal was likely to decrease equity it could be removed.

Broaden the economic base – diversifying the Queensland economy to reduce the nation's dependence on agriculture, tourism, and mining. At 87^{th}, the Harvard University's Atlas of Economic Complexity ranks the Australian economy at the same degree of sophistication as Angola, and lower than Mali and Uganda. Diversifying the economy could be an explicit goal in the Benefit component.

Likely to succeed and would have not otherwise happened (S and P) can be very difficult to estimate. In this case, assume they are both 50 per cent for every project, remove very low value projects on either criteria, and learn.