

Knowledge Dissemination: Determining Impact

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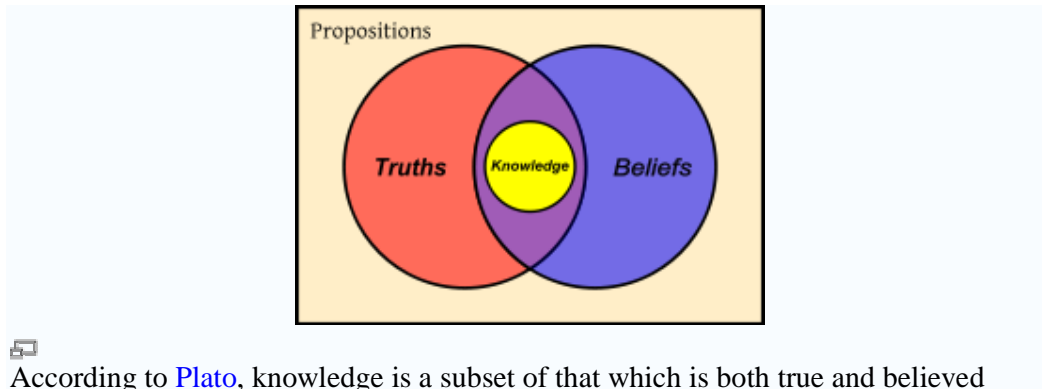
Abstract

Creation, manipulation, management and dissemination of knowledge cannot go on forever without determining what impact it is having on those who create it and those who use it. This paper explores methods of determining the impact of disseminated knowledge. It does this by first defining what knowledge is. This is followed by a discussion on different mediums through which knowledge may be disseminated. It then discusses two questions – when do we know when to disseminate knowledge and how do we know when it has been disseminated. The discussion is followed by a discussion on different methods of monitoring and evaluating disseminated knowledge. It concludes by giving an example of what the CSIR is doing to evaluate the impact of research knowledge it disseminates. Contrary to Plato and Foskett's definition of knowledge, the paper postulates that knowledge is information that is acceptable to a norm about a subject. In treating different mediums that may be used to disseminate knowledge, the paper first argues that mediums of disseminating knowledge can be grouped into two main categories, namely natural and man made mediums. Natural mediums of knowledge dissemination include audio and gestures which are performed by all living beings whereas, man-made mediums include all mediums of communication that man has developed out of transforming matter. Knowledge itself cannot be monitored, only presence in its carrier can. *Ipsa facto*, evaluation of knowledge can be done by analyzing different carriers of it or use thereof, not knowledge itself, because an indisputable truth is that presence of knowledge is only manifest in its application. In monitoring and evaluating knowledge as transformed matter, the criteria of process and progress; relevance, efficiency, effectiveness, impact and sustainability may be used respectively. Techniques of analyzing applied knowledge data abound. Two techniques of applied knowledge analysis which are used in the CSIR namely, Cost-Benefit Analysis and Cost-effectiveness Analysis are discussed.

What is knowledge?

Definitions about knowledge are many and varied.

Foskett (1982) defines knowledge by making a distinction between knowledge and information. He says “*knowledge* is what **I** know, *information* is what **we** know”.



According to [Plato](#), knowledge is a subset of that which is both true and believed

If someone believes something, he or she thinks that it is true, but he or she may be mistaken. This is not the case with knowledge. For example, suppose that Jeff thinks that a particular bridge is safe, and attempts to cross it; unfortunately, the bridge collapses under his weight. We might say that Jeff *believed* that the bridge was safe, but that his belief was mistaken. It would *not* be accurate to say that he *knew* that the bridge was safe, because plainly it was not. For something to count as knowledge, it must actually be true.

I see knowledge as information that is acceptable to a norm about a subject. No one who understands mathematics disputes that $2 + 2 = 4$ because the accepted norm is to use base 10 to add. That is, $2_{10} + 2_{10} = 0_{10}4_{\text{units}}$. This means grouping 2units and 2units into groups of 10 one gets zero 10s and 4units. Hence, $2 + 2 = 4$. If base 2 is used, $2 + 2 = 20$. This is also correct. This is how, $2_2 + 2_2 = 2_20_{\text{units}}$. This means grouping 2 units and 2 units into groups of 2 one gets two groups of two and zero units. Hence, $2 + 2 = 20$. As long as the information that you have conforms to an established and acceptable societal norm, it is knowledge. It does not have to be true. If it conforms to an established norm, it will always be believed. As soon as the norm changes, what you know becomes information. When people do not believe you, it is simply because what you say to them is not acceptable to their norm. Good knowledge is useful knowledge. It permits man's survival by allowing him to use it to solve his problems. When we attend schools or listen to priests preach to us and accept what they tell us as reasonable and pass it on to other people or use it to solve our problems, what we are doing is simply accepting new norms about new or existing subjects.

Mediums for Disseminating Knowledge

Before discussing different platforms for disseminating knowledge, it helps to make a tacit distinction between what Polanyi calls *tacit knowledge* and *explicit knowledge*. According to Polanyi, “...tacit knowledge is what is in our heads and explicit knowledge is what we have codified”

Given that tacit knowledge is knowledge that is in our heads the easiest and the only way to disseminate this type of knowledge is through organs of the body. We can communicate it through voice. This method of communication is largely applied in schools from primary to tertiary. Besides explicit communication, a lot of information and knowledge is passed on from one person to another through gestures. Laughing is a simple sign of happiness. Shrugging your shoulders indicates that you do not know. Of unique interest to note though is that gestures are not universal, they are unique to societies. Nodding one's head means that one is in agreement with what is being said after the European fashion. The converse is true in the Asian culture. In the Asian culture when you shake your head from side to side this means concurrence with what is being said. One of the notable efforts to try to address the problem of different norms and standards on gestures is what has come to be known as the sign language which came into being as an effort to address different human beings impairments such as speech and hearing. This confirms the definition made earlier on that knowledge is that which conforms to a norm about any subject.

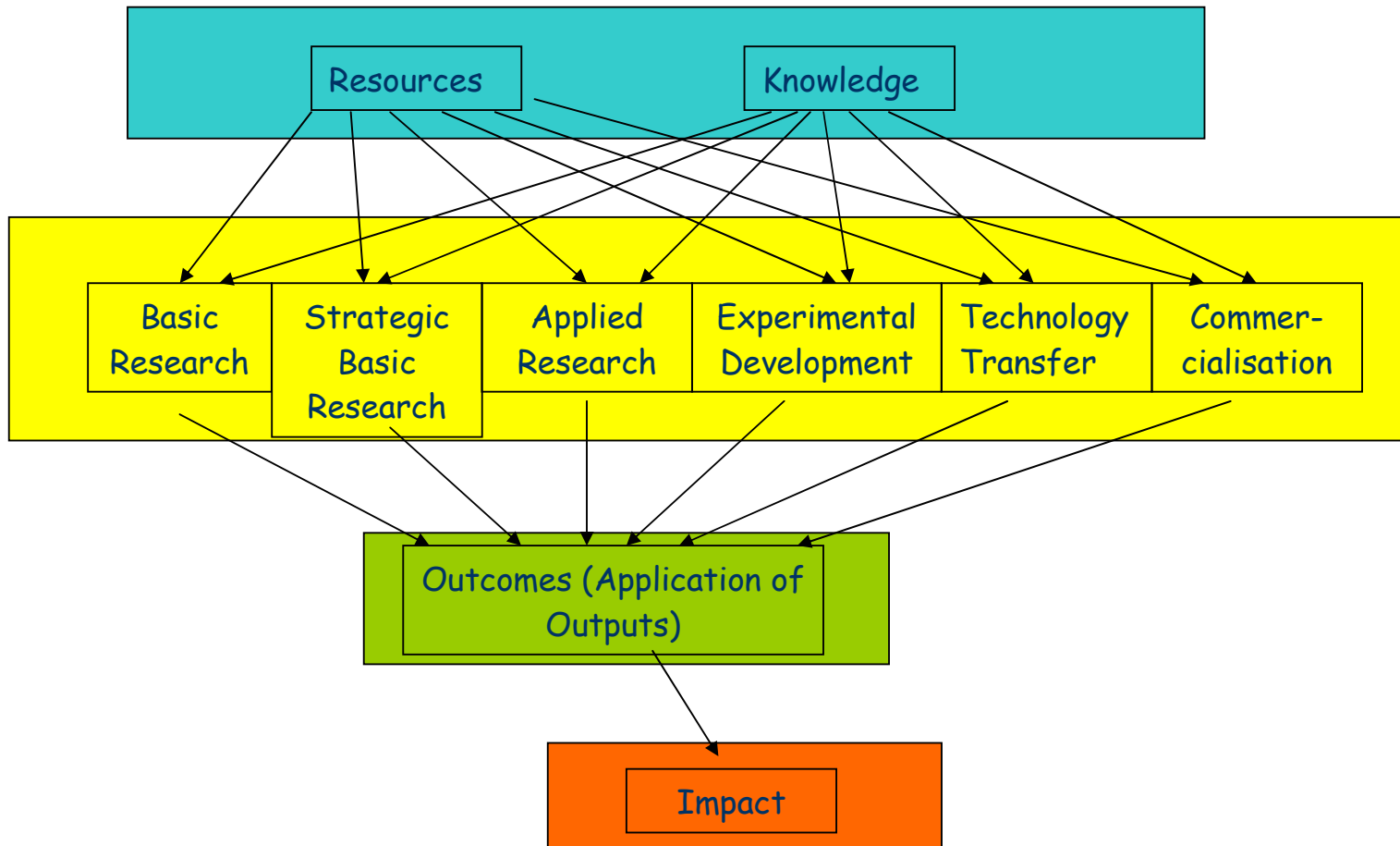
The second type of knowledge is explicit knowledge. This is knowledge that has been codified. How can knowledge be codified? Codification of knowledge came as a result of man's application of tacit knowledge to transform matter into various useful objects for his survival. Writing is the oldest form of codifying knowledge. Most of the world's knowledge is in written form in the form of books. With further transformation of matter through application of tacit knowledge other ways of codifying knowledge have emerged over time. We now find knowledge in mediums such as recorders, the INTERNET and others.

Of particular interest to me is knowledge that is manifest in transformed matter. A spacecraft for example, is a form of transformed matter and an interesting manifestation of knowledge. Houses, cars, guns, computers etc are other forms. Impact of disseminated knowledge can be looked at two levels. The first level is the level where tacit knowledge is codified to explicit knowledge. This in itself is the effect (impact) of knowledge. The different products that we have are an epitome of this. The second level is the usage of these manmade products to solve societal problems. This shows further impact of disseminated knowledge. As will be shown later, the CSIR uses knowledge to develop different solutions to better lives of South Africans. Development of these solutions can be illustrated in the form of an innovation chain as indicated in Figure 1 below.

When should knowledge be disseminated and how do we know when it has been?

There is no stipulated rule on where and when knowledge should be disseminated. The simple answer to this question is knowledge is ready to be disseminated when the holder of it feels it is ready to be. Besides, it does not make sense to acquire knowledge to hoard it. In fact, it is impossible to hoard knowledge because we need to constantly exchange it for survival. Hoarding of knowledge makes sense only when one does it in order to gain comparative advantage over other human beings. Even this is not eternal. Overtime, the hoarded knowledge gets known and is further exchanged. For example, Colonel Saunders has hoarded information about his famous Kentucky Fried Chicken for ages using it to his advantage. Before his death he gave it to his family. This illustrates the point that it can never be hoarded forever.

Figure 1: Innovation Value Chain



Dissemination of knowledge is often done with a certain intention in mind. When this is the key reason for knowledge dissemination, it is important to determine whether knowledge dissemination has really taken place. This is important for a number of reasons. One, it allows for learning on whether knowledge was successfully disseminated so that if not other means of disseminating it successfully could be devised. For example, at institutions of learning gauging of knowledge dissemination is done through tests and examinations as we all know and two, for accountability purposes.

However, the key gauge of whether knowledge has been disseminated is its application. As indicated earlier, as tacit knowledge, knowledge application is seen in the development of different solutions in the form of products and services. In a codified form, knowledge dissemination is seen in the use of the products and services to solve societal problems. Note before, knowledge use does not only lead to useful solutions to societal problems, at times it creates more problems and leads to societal ills. A clear epitome of this is the atomic bomb that was dropped by the Americans on Hiroshima and the current nuclear age in which nuclear bombs, which are an epitome of man's application of his knowledge are a threat to humanity.

Monitoring and Evaluation of knowledge

With a view to making sure that knowledge is disseminated effectively, the concepts of monitoring and evaluation have entered many a field. Let me recap to say that knowledge is manifest in products and services that have come to being as a result of tacit knowledge codification. The application of these products and services is what can be monitored and evaluated for impact over and above monitoring and evaluation of tacit knowledge.

First let me define the concepts of monitoring and evaluation.

Monitoring is a process of continuously assessing both the functioning of an activity in the context of implementation schedules and of the use of activity inputs by the targeted population in the context of design expectations. Two types of monitoring can be cited. These are progress monitoring and process monitoring.

The differences between the progress monitoring and process monitoring are summarized in Table 1 below.

Table 1: Process Monitoring and Progress Monitoring

Process Monitoring	Progress Monitoring
<ul style="list-style-type: none"> • Concerned with key processes for project success 	<ul style="list-style-type: none"> • Primarily concerned with physical inputs and outputs
<ul style="list-style-type: none"> • Measures results against project objectives 	<ul style="list-style-type: none"> • Measures results against project targets
<ul style="list-style-type: none"> • Flexible and adaptive 	<ul style="list-style-type: none"> • Relatively inflexible
<ul style="list-style-type: none"> • Looks at broader socio-economic context in which the project operates, and which affects project outcome 	<ul style="list-style-type: none"> • Focuses on project activities/outcomes
<ul style="list-style-type: none"> • Continuous testing of key processes 	<ul style="list-style-type: none"> • Indicators usually identified up front and remain relatively static
<ul style="list-style-type: none"> • Selection of activities and processes to be 	<ul style="list-style-type: none"> • Monitoring of pre-selected

monitored is iterative, i.e., evolves during process of investigation	indicators/activities
<ul style="list-style-type: none"> Measures both quantitative and qualitative indicators, but main focus is on qualitative indicators 	<ul style="list-style-type: none"> Measures both qualitative and quantitative indicators, but main focus is on quantitative indicators
<ul style="list-style-type: none"> A two-way process where information flows back and forth between field staff and management 	<ul style="list-style-type: none"> A one-way process where information flows in one direction, from field to management
<ul style="list-style-type: none"> People-oriented and interactive 	<ul style="list-style-type: none"> Paper-oriented (use of standard formats)
<ul style="list-style-type: none"> Identifies reasons for problems 	<ul style="list-style-type: none"> Tends to focus on effects of problems
<ul style="list-style-type: none"> Post-action review and follow-up 	<ul style="list-style-type: none"> No post-action review
<ul style="list-style-type: none"> Includes effectiveness of communication between stakeholders at different levels as a key indicator 	<ul style="list-style-type: none"> Takes communication between stakeholders for granted
<ul style="list-style-type: none"> Is self-evaluating and correcting 	<ul style="list-style-type: none"> Is not usually self-evaluating and correcting

Source: World Bank, 1999

The following are among the goals of monitoring:

- To ensure that inputs, work schedules and outputs are proceeding according to plan, i.e., that project implementation is on course;
- To provide record of input use, activities and results; and
- Early warning of deviations from initial goals and expected outcome.

Thus, monitoring is a process which systematically and critically observes events connected to an activity in order to control the activities and adapt them to the conditions. Key steps in the monitoring process are:

- ✓ Recording data on key indicators, largely available from existing sources, such as time sheets, budget reports, supply records.
- ✓ Analysis performed at each functional level management. This is important to assume the flow of both resources and technical information through the system.
- ✓ Reporting, often through quarterly and annual progress reports, oral presentations organized by project staff.
- ✓ Storage, whether manual or computerized, should be accessible to managers at different levels of the system.

The term “evaluation” is defined differently by different authors. There are over 50 definitions in the literature (Michael Quinn Patton 1982). With respect to the definition of evaluation, it is important to keep in mind:

- No single definition will suffice fully to capture the practice of evaluation.
- Different definitions serve different purposes.
- There are fundamental disagreements within the field about the essence and boundaries of evaluation.

In defining the term in any given situation, one should find out the perceptions and definitions of the people with whom one is working. In its general sense, evaluation addresses the question “what has been the effect of the effort?” Any assessments, appraisals, analyses or reviews are in a broad sense evaluative.

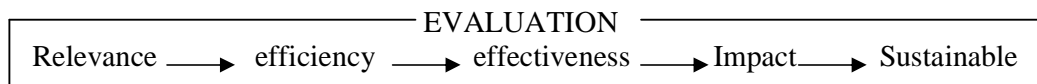
According to the Green Book (2003:5) “Evaluation is similar in technique to appraisal, although it obviously uses historic (actual or estimated) rather than forecast

data, and takes place after the event. Its main purpose is to ensure that lessons are widely learned, communicated and applied when assessing new proposals”.

According to MXA/S &T/Khaya/Simeka Consortium (2000:7) “Evaluation refers to the periodic assessments of issues such as the efficiency, effectiveness, impact, relevance and sustainability of the programme in relation to the stated objectives. Traditionally this involves the running of baseline surveys, with assessments studies being conducted to measure change. A wide range of methods qualitative and quantitative are available”.

The above paragraph brings out something important about impact. Impact assessment is found in the realm of monitoring and evaluation discipline. It is a form of evaluation which determines the effect of an intervention on targeted beneficiaries. Just as evaluation has to be preceded by planning and monitoring for it to be done well, impact assessment as a form of evaluation, is inconclusive without proper prior planning and monitoring. You cannot evaluate anything unless you have planned it in advance and monitored it over time. Therefore, evaluation cum impact assessment always comes after planning and monitoring in that order.

Furthermore, impact assessment is meaningless to do without other forms of evaluation that give it conclusiveness. Overtime, OECD/DAC has identified four forms of evaluation that complement impact assessment and they are relevance, efficiency, effectiveness and sustainability. These stem from the simple logic that a good intervention is one that is relevant to the context within which it is conceived. That is, it solves problems within its context; uses resources efficiently in achieving outputs and objectives; achieves stated objectives; has effect (impact) and is sustainable overtime. Therefore, impact assessment can be looked at as a point on an intervention evaluation continuum as indicated below.



It is also important to note that evaluation is interdisciplinary. It brings together contributions from across the social sciences and related disciplines, including, but not limited to: politics, economics and public administration psychology, sociology and anthropology education, health and law information science and information technology.

It has to be acknowledged though that the term “impact” means different things to different people. In discussing the impact of any research program, one can identify two broad categories of interpretation (Anderson and Herdt, 1990). In the first category, some people look at the direct output of the activity and call this an impact, e.g., a variety, a breed, or a set of recommendations resulting from a research activity. Most of the biological scientists belong to this category.

The second category goes beyond the direct product and tries to study the effects of this product on the ultimate users, i.e., the so-called people level impact. The people level impact looks at how fit the program is within the overall R&D to discover facts (research) that have practical beneficial application (development) to the society. Impact begins to occur only when there is a behavioural change among the potential

users. This second type of impact deals with the actual adoption of the research output and subsequent effects on production, income, environment and/or whatever the development objectives may be. The people level impact of any research activity cannot be assessed without information about the (extent) number of users and the degree (intensity) of adoption of improved techniques, and the incremental effects of these techniques on the production costs and output. The adoption of any technology is determined by several factors, which are not part of the original research activity.

In any comprehensive impact assessment, there is therefore a need to differentiate between the research results and the contributions of research to development, i.e., the people level impact, and both aspects should be addressed. Impact Assessment is directed at establishing, with certainty, whether or not an intervention is producing its intended effect. A program that has positive impact is one that achieves some positive movement or change in relation to objectives. This implies a set of operationally defined goals and a criterion of success. There is also a need to establish that the outcome is the cause of some specified effort. As such, it is important to demonstrate that the changes observed are a function of the specific interventions and cannot be accounted for in any other way. The three basic principles to be observed in any impact study are causality, attribution, and incrementality.

The other four aspects of evaluation that give impact assessment/evaluation conclusiveness are defined as follows:

Relevance looks at the extent to which the objectives of an activity are consistent with beneficiaries' needs, country needs and global priorities. It also looks at whether the activity's objectives and overall goal provide proper solutions to the problems identified in the area or sectors concerned.

Effectiveness relates to the question of whether the implementation of the activity has actually benefited (or will benefit) the intended beneficiaries and the target group. It answers the question, has it produced the expected results?

Efficiency is a criterion concerning the relations between the activity costs and its outputs. The main question that is asked to judge the efficiency of an activity is whether the degree of output justifies (or will justify) the costs (input), in other words, whether there was no alternative means of securing the same achievements at lower cost, or whether it was impossible to attain greater achievements at the same cost.

Sustainability is a criterion that examines whether the effects produced by the activity have been sustained (or are likely to be sustained) even after the activity completion.

How then can monitoring and evaluation of disseminated knowledge be done using the above criteria of process and progress and relevance, efficiency, effectiveness, impact and sustainability respectively? Let us look at the CSIR.

Monitoring and Evaluation of the CSIR's knowledge

The CSIR's reason for existence is captured in its mandate which reads as follows:

In the national interest, the CSIR, through directed and multi-disciplinary research and technological innovation, should foster industrial and scientific development, either by itself, or in partnership with public and private sector institutions, to contribute to the improvement of the quality of life of the people of South Africa

The above mandate immediately indicates that CSIR's reason for existence is to generate knowledge through research and technological innovation and solve problems with it.

In the CSIR, knowledge is generated and exists in the two forms of tacit knowledge and explicit knowledge as is the case in other organizations. Tacit knowledge is in all CSIR staff of 3 000 employees with their Diplomas, Bachelors, Masters and PhD degrees. CSIR explicit knowledge is in the form of publications, reports, patents, copyrights, products and services.

Who is CSIR target in disseminating knowledge? The CSIR disseminates information to the internal as well as the external stakeholders. The internal stakeholders include those who have tacit knowledge within the organization, its staff. When knowledge is disseminated to staff the objective is to have impact in the following areas of the organization's activities:

- **Strategic Planning**
 - Our past informs our future
- **Reporting**
 - We have to report on our activities as we perform our work
- **To determine whether the CSIR is living up to its mandate**
 - If it is, then its reason for existence is justified

How is the knowledge disseminated internally? The CSIR has a number of knowledge management systems which include an information centre called CSIRIS, Technical Outputs DataBase (TODB) and Intellectual Property Management System (IPMS). CSIRIS is a cache of all books, reports, publications that the CSIR has. It works like a library. It is a resource centre that is used by the CSIR's employees in their work. It is also open to people from outside the organization who work in the field of research.

TODB is a repository of all technical information that the CSIR has. It is also used for reference purposes. The difference between this resource and CSIRIS is that contrary to CSIRIS, TODB is used only by the CSIR staff members.

IPMS, as its name implies is a repository of all intellectual property that the CSIR generates out of its research work. This is also used internally by the CSIR.

External stakeholders include those who benefit from CSIR's knowledge and those within the National System of Innovation and beyond, such as government, other science councils, academic institutions, private sector etc. When knowledge is disseminated to the external stakeholders the intention is to have an impact in

improving the lives of its intended beneficiaries. Besides improving lives the information is disseminated

- **To account to Parliament for the funds being allocated to the CSIR**
 - Be able to show evidence of the effects of the money it spends
- **To inform society about CSIR's effect on their lives (especially the positive impact)**
 - Celebrate its successes

In order to disseminate knowledge to the potential beneficiaries and solve their problems, the CSIR implements projects in the following sectors:

- Biosciences
- Natural Environment
- Defence, Peace, Safety and Security
- Built Environment
- Material Science and Manufacturing

Over and above the five areas, the organization has a number of centres that have been established to deal within societal problems in different areas of strategic importance.

In determining the effect of disseminated knowledge, especially explicit knowledge, the CSIR uses the five OECD/DAC evaluation criteria or relevance, efficiency, effectiveness, impact and sustainability referred to earlier on.

In order to permit for assessment, the LogFrame tool of project planning is utilised. The logical framework (Logframe) was developed in the 1960s by USAID and today its use is widespread throughout the development community by for example, DFID, EU, FAO, GTZ and the World Bank. One of its principal strengths is its relevance to several stages of the project cycle: not only does it guide project preparation it is also used as a basis for project monitoring and evaluation (Commission of the European Communities, 1993). Although it is constructed during the planning stage of a project, the Log Frame is a living document, which should be consulted and altered throughout a project's life cycle.

The Log Frame asks a series of questions:

- Where do we want to be? (GOAL, PURPOSE)
- How will we get there? (OUTPUTS, ACTIVITIES)
- How will we know when we have got there? (INDICATORS)
- What will show us we have got there? (EVIDENCE)
- What are the potential problems along the way? (ASSUMPTIONS)

Techniques of data analysis in order to determine impact

A number of techniques are applied to perform impact assessment. These include Cost Benefit Analysis, Cost-Effectiveness Analysis, Econometric Analysis, Linear Programming and others. The table below gives a number of the techniques and also indicates the criteria of evaluation which they support. The table is based on assessing knowledge disseminated through a project.

PROJECT NAME								
(1) PROJECT LOGICAL FRAMEWORK – PLANNING				EVALUATION CRITERIA				
Risks/Assumptions	Means of Verification	Verifiable Indicators	Narrative Summary	Relevance	Effectiveness	Efficiency	Impact	Sustainability
			<i>Project Overall Goal:</i>	Conformity of Project Purpose and Overall Goal to the recipient country's needs at the time of evaluation	Degree to which the achievement of Project Purpose is seen in the Output		Positive and negative influences that appeared directly and indirectly as a result of the project	Extent to which benefits gained through the project are sustained even after the completion of cooperation
			<i>Project Purpose:</i>					
			<i>Project Outputs:</i>			Extent to which Inputs are effectively converted into Outputs		
			<i>Project Inputs:</i>					
(2) PROJECT LOGICAL FRAMEWORK – EVALUATION				EVALUATION TECHNIQUE				
Risks/Assumptions	Means of Verification	Verifiable Indicators	Narrative Summary	<ul style="list-style-type: none"> Overall goal and Project Objectives' comparative analysis 	<ul style="list-style-type: none"> Statistical Analysis Quasi-experimental Analysis Performance Measurement Analysis Patent Analysis 	<ul style="list-style-type: none"> Cost Benefit Analysis Cost Effectiveness Analysis Cost Analysis Mathematical Programming 	<ul style="list-style-type: none"> Modified peer reviews User Surveys Benefit Cost Methods <ul style="list-style-type: none"> NPV IRR Pay Back Period Benefit Cost Ratio Econometric Analysis 	<ul style="list-style-type: none"> Trend plotting and analysis
			<i>Project Overall Goal:</i>					
			<i>Project Purpose:</i>					
			<i>Project Outputs:</i>					
			<i>Project Inputs:</i>					

Out of the above techniques, let me discuss two.

Cost-effectiveness

Cost-effectiveness analysis is a decision-making assistance tool. It identifies the economically most efficient way to fulfil an objective. In evaluation, the tool can be used to discuss the economic efficiency of a programme or a project. Focused on the targeted major result of the activity – the number of jobs created – the tool estimates the cost of each job generated by a specific measure. The comparison of various programmes with similar impacts enables the comparison of the costs generated by each job created and provides useful quantitative indicators for the selection of comparative methodologies.

The tool compares policies, programmes or projects. It presents alternatives in order to identify the most appropriate one to achieve a result at least cost. Cost-effectiveness analysis may contribute to answer the following questions:

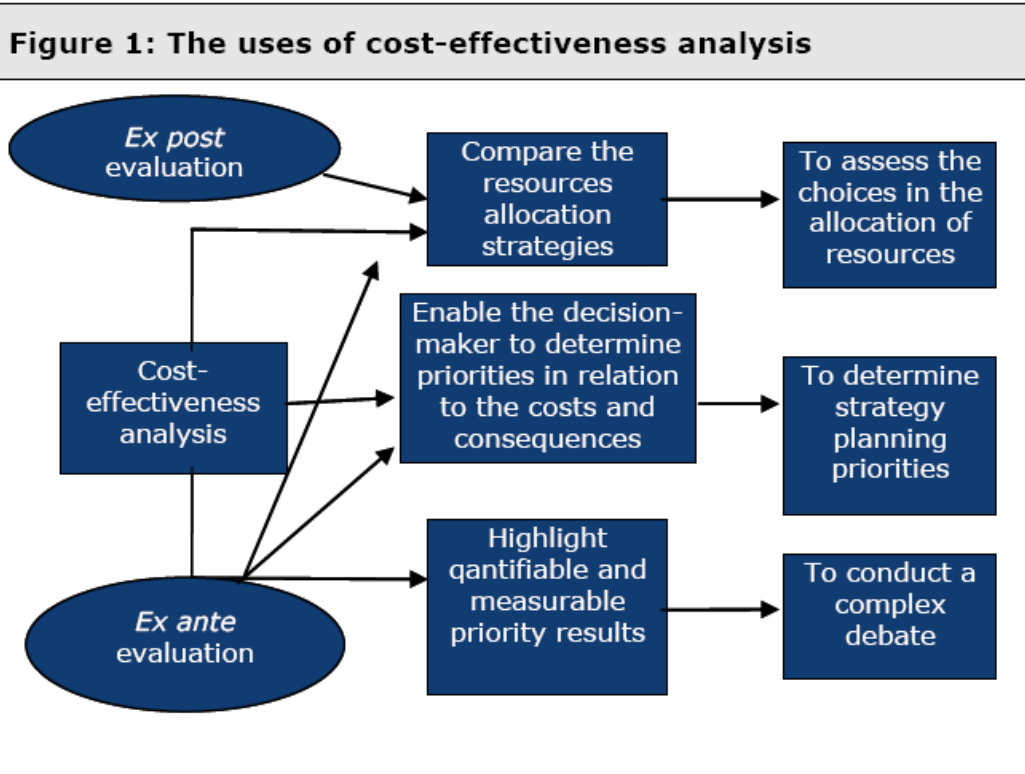
- How much does a programme or a measure cost compared with the cost of a particular component of its objective?
- Is it preferable to invest resources in an intervention, to the detriment of another, to achieve the target?
- What kind of intervention or group of interventions yields the best outcomes regarding the final objectives and available resources?
- How can the use of the resources be optimised, given competing needs between programmes?
- At what level of additional investment will the chosen intervention clearly give an improved outcome?

Cost-effectiveness analysis can be used in:

- ***Ex ante* evaluations** to support decision-making and guide the choices to be made.

Depending on the cases, it can be used:

- To foster the debate among decision-makers prior to the decision
 - To highlight the preferences of the groups representing different categories of stakeholders or actors involved in the sectors where the intervention is planned
 - ***Ex post* evaluations** to measure the economic efficiency of an intervention already carried out.
-
- **Intermediary evaluation** to update the *ex ante* outcomes and choose which options should be selected to continue the intervention.



Cost-Benefit Analysis

A cost benefit analysis is done to determine how well, or how poorly, a planned action will turn out. Although a cost benefit analysis can be used for almost anything, it is most commonly done on financial questions. Since the cost benefit analysis relies on the addition of positive factors and the subtraction of negative ones to determine a net result, it is also known as running the numbers.

A cost benefit analysis finds, quantifies, and adds all the positive factors. These are the benefits. Then it identifies, quantifies, and subtracts all the negatives, the costs. The difference between the two indicates whether the planned action is advisable. The real trick to doing a cost benefit analysis well is making sure you include all the costs and all the benefits and properly quantify them.

Should we hire an additional sales person or assign overtime? Is it a good idea to purchase the new stamping machine? Will we be better off putting our free cash flow into securities rather than investing in additional capital equipment? Each of these questions can be answered by doing a proper cost benefit analysis.

After data has been analysed and the evaluation is complete, the evaluation report has to be distributed to ensure that knowledge from the CSIR is disseminated.

Apart from distributing the evaluation report itself, the most common ways through which evaluation information is disseminated include evaluation summaries, annual reports, bibliographies, thematic reports, the web, seminars, press releases, and public debate.

Whatever channel is preferred, the best way to ensure dissemination of lessons learned and knowledge gained in evaluations is to improve both the content of reports and the presentation of material. A key benefit of good dissemination practises is transparency of development interventions and public insight into their value.

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