Examples of Applied Research Projects

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1. Introduction

Although there exists no single hard definition of applied research, certain factors can help determine whether a research effort is *basic* or *applied*. *Basic* (also known as *fundamental* or *pure*) research is driven by a researcher's curiosity or interest in a scientific question (e.g., what causes gravity?). The main motivation is to expand human knowledge, not to create or invent something for immediate use. In contrast, *applied* research is designed to solve practical problems of the modern world, usually in response to a specific articulated need from an agency or company (e.g., develop a means for reducing aerodynamic drag on tractor-trailer rigs to improve gas mileage).

Another way to frame the difference between *basic* and *applied* research is to describe the research in terms of *expectations*.   The expectation for *basic* research is to explore and follow a path to discovery. Funding sponsors value the process of discovery rather than specific tangible products that result from the research. The *basic* research effort may yield discoveries or results that were not envisioned or anticipated at the beginning of the research effort. However these discoveries are still valued by the funding sponsor. In contrast, the expectation for *applied* research is to solve an immediate problem and provide a near-term practical solution. The funding sponsor expects a product or research deliverable, mostly frequently based upon specifications provided in advance, that has commercial or tangible value for meeting an identified need. There is both a defined goal and outcome that are understood at the beginning of the *applied* research project.

Applied research and development projects involve higher levels of technology maturity than do *basic* research projects. NASA has developed the concept *of technology readiness levels* (TRL) to describe the maturity of technology. Figure 1 illustrates the concept of TRL. In general, *basic* research ends around TRL 3 or 4, whereas *applied* research and development ends at TRL 6 or higher. Typically, if a TRL goal is stated for a research project, then the project is most likely *applied* research and development.

2. Applied Research and Development Examples

The following examples describe possible scenarios for applied research projects as well as applied development projects. The level and type of involvement of faculty researchers can differ based on the scope of work. In some cases, faculty can perform work as consultants through CARD, whereas in other cases the faculty researchers are directly involved as principal investigators.

The following are examples of applied projects and include the CARD evaluation matrix.
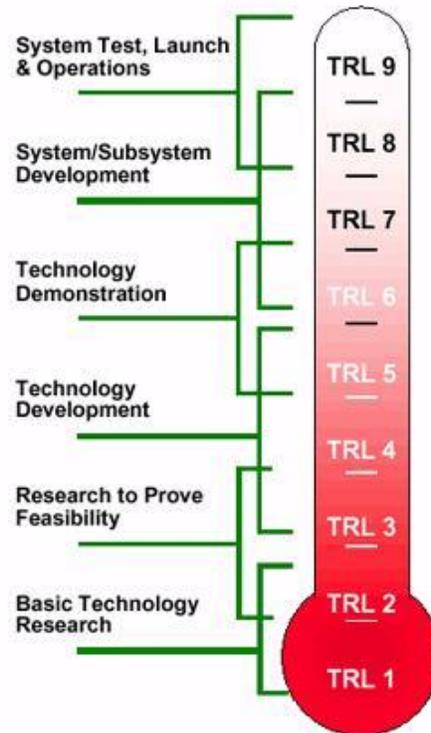
Figure 1. NASA Technology Readiness Levels (TRL)

Example #1: Applied Research Project

Based on discoveries from an NSF-funded research effort, an OU faculty researcher identifies an application of the research results that can help increase agricultural crop production yields. The original NSF-funded effort resulted in one patent awarded to the faculty researcher and OU and several papers were published in peer-reviewed journals. The *technology readiness level* (TRL) of the research was assessed at the end of the NSF project and determined to be at TRL 3. A large corporation is interested in licensing the technology, but requests that the university research team perform more research to refine and demonstrate the specific processes needed for the technology. The corporation will fund the research to develop, refine and demonstrate the processes. The corporation places a publication restriction on the research and development of the specific processes. The corporation will negotiate an intellectual property agreement with the university that specifies the intellectual property ownership rights. The expectation is that the research results will be at a minimum of TRL 6 at the end of the second phase of research, which means the company can soon begin commercial sales using the technology. The effort is funded by a fixed-price contract award from the corporation and is a performance-based contract and not a grant.

Classification:

The original research is considered *basic* research since it was funded by NSF. However, the second stage of research (funded by the corporation) would be considered *applied*

since the continued research is driven by a specific application. There is an expectation of practical results from the second stage of research. The funding sponsor (corporation) is not specifically interested in new discoveries, but rather the refinement of previous results that have near-term applications. The effort is funded as a performance-based contract and is not a grant. The publication restriction is another factor that implies that the research project is an *applied* versus *basic* research effort.

The completed CARD project evaluation matrix is included in Table 1.

Table 1: CARD Project Evaluation Matrix for Example 1

Question	Yes	No
Does the project involve applied (not basic or inquiry-driven) research or development that seeks to perform specific tasks requested by the funding organization and/or has defined deliverables?	■	
Does the project have publication restrictions?	■	
Is the project funded by a mission agency or office?	■	
Is the project funded by a contract or procurement vehicle rather than a grant or cooperative agreement?	■	
Does the project involve teaming or collaboration with a non-academic entity?	■	
Are there specific TRL or MRL requirements or goals for the research?	■	
Does the funding organization retain the rights to intellectual property generated during the course of the project and/or could the project be considered a "work for hire"?	■	
Does the project have explicitly-stated manufacturing and production plans, goals or requirements?		■
Does the project involve continued development and expansion of intellectual property developed outside of OU?		■
Does the project involve non-faculty researchers as principal investigators or project lead researchers?		■
Are there specific requirements for participation by an industry partner as a contractual part of the research?	■	
Does the funding or sponsor organization require an unlimited use license or retain other rights to the use of the research results or products?		■
Does the project have performance or delivery schedules that are based on calendar years (such as monthly deliverables) and difficult to reconcile or align with academic calendars?	■	

Example #2: Applied Development Project

As part of an urban renewal project, a local municipal planning group (funded by an economic development authority) decides to fund a team of university researchers to assist in the development of a strategic growth plan for a city. The municipal planning group requests that the team consider factors such as renewable energy, ecological protection, and economic and industrial growth and deliver a study that the planning group can use for long-term strategic planning for the city. The municipality places no publication restriction on the project and asserts no claims to intellectual property. The final deliverable for the project is a comprehensive study and recommendations for a strategic growth plan. The funding milestones are based on specific project deliverables (interim project briefings, delivery of final report, etc.). The effort is funded with a fixed price contract from the economic development authority and is not considered a grant.

Classification:

This type of project would be considered *applied consulting* and *applied development*. Although it is possible that there could be scholarly publishing opportunities for specific components of the project (renewable energy, ecology, etc.), the expectation of the funding sponsor is for a study that will guide the development of a practical plan.   Also, the effort is funded as a performance-based contract rather than as a grant.

The completed CARD project evaluation matrix is included in Table 2.

Table 2: CARD Project Evaluation Matrix for Example 2

	Question	Yes	No
1	Does the project involve applied (not basic or inquiry-driven) research or development that seeks to perform specific tasks requested by the funding organization and/or has defined deliverables?	■	
2	Does the project have publication restrictions?		■
3	Is the project funded by a mission agency or office?	■	
4	Is the project funded by a contract or procurement vehicle rather than a grant or cooperative agreement?	■	
5	Does the project involve teaming or collaboration with a non-academic entity?	■	
6	Are there specific TRL or MRL requirements or goals for the research?		■
7	Does the funding organization retain the rights to intellectual property generated during the course of the project and/or could the project be considered a "work for hire"?		■
8	Does the project have explicitly-stated manufacturing and production plans, goals or requirements?		■
9	Does the project involve continued development and expansion of intellectual property developed outside of OU?		■
10	Does the project involve non-faculty researchers as principal investigators or project lead researchers?		■
11	Are there specific requirements for participation by an industry partner as a contractual part of the research?		■
12	Does the funding or sponsor organization require an unlimited use license or retain other rights to the use of the research results or products?	■	
13	Does the project have performance or delivery schedules that are based on calendar years (such as monthly deliverables) and difficult to reconcile or align with academic calendars?	■	

Example #3: Applied Research Project

A university research team has identified a new technique for storing and using liquefied natural gas (LNG) for use in a variety of fleet vehicles. It is anticipated that the new technology will result in a reduction harmful emissions and improved fuel economy compared to traditional fossil fuels. The technology concept was identified during the course of a Department of Energy (DOE) funded effort through a research grant. Several publications resulted from the research and the university team was awarded 2 patents on the technology. The technology has not been demonstrated in an operational vehicle. A branch of the U.S. military is interested in evaluating the new technology in some of its vehicles to assess the viability of the technology and determine if there are quantifiable benefits from using the technology in fleet vehicles. The military funds a study and demonstration of the technology using military-owned vehicles. The project is funded with a large Department of Defense engineering services indefinite delivery / indefinite quantity (ID/IQ) task order award (not a grant). The expectation by the military is that the research project will be at TRL 6 by the end of the effort. The military places a publication restriction on the study since it involves specific military vehicles and mission scenarios. However, the scope of the publication restriction covers the study and demonstration only and does not impede the general scholarly endeavors of the research team.   No new intellectual property is likely to be developed during the study. The study and demonstration will be funded through an engineering services contract with defined milestones and prototype deliverables.

Classification:

Since the study and demonstration is a feasibility study that will be funded by a performance-based contract with defined milestones and deliverables rather than a grant, the project is more likely to be considered an applied project. The publication restrictions are another indicator that the project is applied versus basic research. The original DOE-funded effort was a basic research effort due to the funding mechanism and research sponsor. The effort is funded using a task order with a large ID/IQ contract vehicle. The project also includes explicit TRL goals that imply that the project is *applied* versus *basic* research. The completed CARD evaluation matrix is included in Table 3.

Table 3: CARD Project Evaluation Matrix for Example 3

	Question	Yes	No
1	Does the project involve applied (not basic or inquiry-driven) research or development that seeks to perform specific tasks requested by the funding organization and/or has defined deliverables?	■	
2	Does the project have publication restrictions?	■	
3	Is the project funded by a mission agency or office?	■	
4	Is the project funded by a contract or procurement vehicle rather than a grant or cooperative agreement?	■	
5	Does the project involve teaming or collaboration with a non-academic entity?		■
6	Are there specific TRL or MRL requirements or goals for the research?	■	
7	Does the funding organization retain the rights to intellectual property generated during the course of the project and/or could the project be considered a "work for hire"?		■
8	Does the project have explicitly-stated manufacturing and production plans, goals or requirements?		■
9	Does the project involve continued development and expansion of intellectual property developed outside of OU?		■
10	Does the project involve non-faculty researchers as principal investigators or project lead researchers?		■
11	Are there specific requirements for participation by an industry partner as a contractual part of the research?		■
12	Does the funding or sponsor organization require an unlimited use license or retain other rights to the use of the research results or products?	■	
13	Does the project have performance or delivery schedules that are based on calendar years (such as monthly deliverables) and difficult to reconcile or align with academic calendars?	■	

Example #4: Applied Development Project

A group of faculty researchers have developed a set of new data-mining and text-mining algorithms that enable rapid entity detection for large sources of streaming unstructured text. The faculty researchers publish two papers in peer-reviewed journals and one PhD dissertation is completed on the subject. One of the federal intelligence agencies provides funding for the university to develop a software tool using the new algorithms. The intelligence agency will provide access to other software packages, some of which are classified, to assist in the development. The goal of the project is to integrate the software package to be developed by the university into a larger intelligence-related software system planned for release within the larger intelligence community. The project has a blanket publication restriction and the university researchers are each required to have and maintain a SECRET security clearance since they researchers may need access to classified test data. The project is funded using a federal information technology (IT) services contract (ID/IQ) and several task order awards are anticipated. The university will also hire additional software development experts and programmers to assist in the project. The project has well-defined deliverable milestones including monthly status reports, quarterly program reviews, and incremental prototype demonstrations and deliverables.   The funding agency will use a larger contract vehicle to provide funding. The funding agency will retains all rights and usage licensing for the software package and system. The overall program manager will reside in CARD.

Classification:

This project is considered an applied development project due to several factors. The first is the publication restriction. Although the research faculty have already published on the initial algorithm research, the funding agency will restrict additional publishing on the specific development effort. The project is also funded by a mission agency (intelligence agency) and using task order awards using an ID/IQ contract vehicle. The project will result in a mature deliverable (high TRL) that will be used by the funding agency and intelligence community at-large. The project also has well-defined deliverables and project milestones that do not correspond to the academic calendar. The project will also involve integration with intellectual property and technology developed outside of the university.   Finally, the funding agency will retain all ownership rights to the software package.

A completed CARD project evaluation matrix is included as Table 4.

Table 4: CARD Project Evaluation Matrix for Example 4

#	Question	Yes	No
1	Does the project involve applied (not basic or inquiry-driven) research or development that seeks to perform specific tasks requested by the funding organization and/or has defined deliverables?		■
2	Does the project have publication restrictions?	■	
3	Is the project funded by a mission agency or office?	■	
4	Is the project funded by a contract or procurement vehicle rather than a grant or cooperative agreement?	■	
5	Does the project involve teaming or collaboration with a non-academic entity?	■	
6	Are there specific TRL or MRL requirements or goals for the research?	■	
7	Does the funding organization retain the rights to intellectual property generated during the course of the project and/or could the project be considered a "work for hire"?	■	
8	Does the project have explicitly-stated manufacturing and production plans, goals or requirements?		■
9	Does the project involve continued development and expansion of intellectual property developed outside of OU?	■	
10	Does the project involve non-faculty researchers as principal investigators or project lead researchers?	■	
11	Are there specific requirements for participation by an industry partner as a contractual part of the research?	■	
12	Does the funding or sponsor organization require an unlimited use license or retain other rights to the use of the research results or products?	■	
13	Does the project have performance or delivery schedules that are based on calendar years (such as monthly deliverables) and difficult to reconcile or align with academic calendars?	■	