Validation of examples of R&D

Attachment A
List of Fields and Examples

Field	Example
Agricultural Sciences	Researchers investigate genome changes and mutagenic factors in plants to understand their effects on the phenome.
Agricultural Sciences	Researchers investigate the connection between the genome, phenome, and environment in maize by producing identical seeds and sending them to researchers across the country to plant and observe.
Agricultural Sciences	Researchers investigate wild potato genomes to locate the genes responsible for resistance to potato blight in an effort to improve the disease resistance in domestic/crop potatoes.
Agricultural Sciences	An investigator creates a tool known as CRISPR (clustered regularly interspaced short palindromic repeats), which is used for gene editing, by using knowledge of how enzymes edit DNA.
Archeology	Researchers analyze pottery shards from a settlement to find where the clay originated, tracing the flow of goods and raw material to its source.
Archeology	Researchers conduct a 25-year-long project to map the entirety of the ruins of Teotihuacán, in Mexico.
Archeology	Archeologists survey a site that will be built over by a new highway project and document and preserve any archeological remains that may be destroyed by the project.
Archeology	A private company creates a model to predict the locations of unsurveyed archaeological sites on military bases. The company conducts several case studies to create and fine-tune the model.
Archeology	Researchers create a new technique for getting starch grains out of dental calculus, allowing researchers to analyze the diets of ancient peoples from their teeth.
Archeology	A university research team attempts to replicate an ancient metallurgical technique for making iron tools from data collected from archaeological sites where such iron tools were found.
Art	A university hosts a playwright in residence who tests ideas and creative materials by working with faculty and students. No specific products are expected from the arrangement.
Art	An artist investigates stainless steel to acquire the correct equipment and the necessary training to weld steel and shape it as necessary for his art objects.
Art	A team of mathematicians, an architect, an engineer, and an artist create a design tool that allows one to construct a digital representation of a sculpture that would behave as if it was susceptible to real world forces.
Art	Researchers conduct anthropological studies to understand participation in an ecosystem of arts and culture in a particular community by mapping the nodes (such as churches or formal arts centers) that provide opportunities for arts and cultural engagement in that community.
Art	A health and retirement survey, conducted to gather insights into the health status of older adults, examines how they engage with the arts with the aim of determining if arts engagement affects their health and psychological states.
Art	Researchers modify art therapy techniques that are used to help soldiers recovering from post-war syndrome and tailor them to help autistic children enhance their social

Field	Example
	skills.
Art History	Art historians investigate the motivations behind the creation and use of commemorative decorative pins made following the American Revolutionary War.
Art History	Art historians investigate methods to preserve and restore types of artwork that have deteriorated over time.
Art History	Art historians use insights from art history and archeological research to create digital recreations of partially or fully destroyed pieces of art (e.g., fragments of mosaic in a Roman villa), making them faithful to their known or likely original appearance.
Basic Medicine	Researchers use fMRI to map activation in the brain while subjects are performing various tasks in the scanner.
Basic Medicine	Researchers examine the mechanisms of the virus that causes viral gastroenteritis to increase knowledge of the disease and viruses in general.
Basic Medicine	Researchers monitor the health status and progression of Alzheimer's among a cohort of aging subjects.
Basic Medicine	Researchers image prostate biopsy interventions to study the treatment of prostate cancer.
Basic Medicine	Researchers develop instruments for tracking eye movement that work while a subject is being scanned in an MRI.
Basic Medicine	Researchers use methods originally developed for measuring paint by analyzing the change in resistivity of the liquid as it flows through a loop to measure the number of white blood cells in a body.
Biological Sciences	Researchers investigate the existence and mechanisms of life in extreme environments such as the Yellowstone hot springs.
Biological Sciences	Researchers alter a protein's structure and investigate the effect on cancer cells to improve the longevity of the protein's ability to defeat cancer cells.
Biological Sciences	Investigators use knowledge obtained from research into heat stable polymerase (Taq polymerase) isolated from heat stable proteins and used it in the polymerase chain reaction to improve their method of amplifying DNA strands.
Chemical Sciences	Researchers examine small molecules through high-resolution spectroscopy to understand the size, strength, and other physical properties of the molecules.
Chemical Sciences	Researchers examine certain chemicals contained in pine needles for a potential treatment of breast cancer.
Chemical Sciences	An investigator uses existing knowledge of electronics and trial and error to come up with a lighting device that has the necessary qualities to be brought to market.
Chemical Sciences	Researchers investigate the role of the enzyme protease in relation to the lifecycle of the HIV/AIDS virus.
Chemical Sciences	Researchers attempt to find an inhibitor of the enzyme protease because they knew that it is crucial to the lifecycle of HIV/AIDS.
Chemical Sciences	Researchers put newly formulated drugs through clinical trials to ensure that the drugs have the intended effect.
Chemical Sciences	A chemical engineer develops the process to mass-produce a new drug.
Computer and Informational Sciences	Computer scientists investigate simple models to characterize why things with some level of dependence on each other fail.
Computer and Informational Sciences	Computer scientists investigate algorithms that industry uses to track human activities and how the industry directs targeted product advertisements at potential customers based on their online behaviors.
Computer and	Computer scientists investigate ways to reduce the amount of spam by understanding

Field	Example
Informational Sciences	the whole structure or business model of spam, what spammers do, and their motivations in spamming.
Computer and Informational Sciences	Researchers create customized chips used for processing images in all kinds of computerized thermography like X-Rays, CT scans, and MRIs to reduce processing time.
Computer and Informational Sciences	A start-up company takes code developed by researchers that finds coding mistakes in software code, understands the context in which the code may be used, and creates the business case for the resulting software product.
Computer and Informational Sciences	Data scientists develop highly experimental data analytics where existing methods are used in new types of analyses on large amounts of data collected by various government organizations.
Economics and Business	Economists conduct abstract research in economic theory that focuses on whether a natural equilibrium exists in a market economy.
Economics and Business	Economists create methods for the FCC to auction the telecommunications spectrum.
Economics and Business	Researchers create economic indicators by investigating the characteristics and productivity levels of industries to understand the connections and the implications for firm survival, growth, and exit.
Economics and Business	Researchers tweak the code and training to customize spectrum auction methods used by the FCC spectrum auctions for a new country.
Economics and Business	An agency creates a tool where a manager can enter information on an establishment and benchmark it against the distribution of responses obtained from a survey on global management practices at manufacturing firms.
Educational Sciences	Researchers investigate the effect of different types of manipulatives on the way first graders learn mathematical strategy by changing manipulatives and then measuring what students have learned through standardized instruments.
Educational Sciences	Neuroscientists examine brain scans of children who experience high anxiety with math in school.
Educational Sciences	Researchers study the implementation of a specific math curriculum to determine what teachers needed to know to implement the curriculum successfully.
Educational Sciences	Researchers investigate if specific educational interventions increase retention of engineering and computer science undergraduate students.
Educational Sciences	Researchers develop hierarchical linear modeling to allow researchers to assess the impact of external factors such as the geographical location, district, school, etc.
Educational Sciences	Researchers create special education software and support tools based on fieldwork.
Ethics	Researchers conduct a study that has human subjects consider ethical scenarios, then observe the decisions they make and the factors that impact those decisions.
Ethics	Researchers conduct a study asking what it means to be an autonomous moral agent.
Ethics	An ethicist studies if it is ethically acceptable to use a placebo in drug trials.
Ethics	Ethicists create a new IRB rule concerning the use of surveys on human subjects.
Ethics	Ethicists examine the degree to which individuals under coercion or duress should be held responsible for their actions.
Ethics	Researchers examine why the pharmaceutical industry has an empirically higher than average rate of ethical violations (measured by frequency of government settlements) than other industries when such behavior is contrary to the explicitly stated mission of industry member companies of improving patient welfare.
Ethics	Ethicists tailor consent communications for healthcare environments, to ensure that

Field	Example
	the appropriate information is provided to patients so that they can make informed choices about their medical treatment and care.
Ethics	Ethicists design an employee-screening instrument that companies can use to evaluate the ethical orientation of potential employees.
Forestry	Researchers investigate the genetics of the species of plants in a forest in an attempt to locate genes that control diseases or repel pests.
Forestry	Researchers plant experimental forests where they alter the spacing and alignment of the trees to determine the optimum arrangement for maximum yield.
Forestry	Researchers use existing research on a specific plant species to create a plan for improving how a company plants its forests to achieve a specific goal.
History	Historians study the history and human impact of jökulhlaups, glacial outburst floods in Iceland that can rapidly release massive amounts of meltwater accumulated behind ice barriers.
History	Historians study the training and education of officials in charge of administering the territories and foreign relations of the early French colonial empire.
History	Historians examine past societies' responses to catastrophic natural events (e.g. , floods, droughts, epidemics, etc.), in order to understand how contemporary society might better respond to global climate change.
History	Historians examine the history of economic inequality in past societies to inform policy responses to current-day economic inequality.
History	Historians use historical insights to design or improve museum exhibits on past human societies.
History	Historians create a museum exhibit and companion book and video documentary on the Louisiana Purchase.
Language	Linguists infer both the existence of a deep structure of language and the operations used in its generation from the existence of inconsistencies in the meanings of simple sentences and, by categorizing those sentences, attempt to define the deep structure and operations.
Language	Linguists use linguistic theories to help bridge the gap in coherence between machine translation, based on statistical rules derived from the analysis of previously translated texts, and natural human translation.
Language	Linguists study how languages interact as they come into contact with one another.
Language	Speech therapists examine the governing neurology of languages and how humans acquire language skills.
Language	Linguists develop a diagnostic tool for diagnosing autism in children based on their use of signs.
Law	Researchers study how the process of suspect presentation in a line up influences the accuracy of the process.
Law	Researchers examine how the structure of a voting system affects the outcomes of the vote.
Law	Researchers examine how laws are put into practice to determine the difference between how laws are written and how laws are applied ("gap studies").
Law	Researchers examine how people identify members of different races and cultures with an eye toward understanding the reliability of eyewitnesses in criminal trials.
Law	Researchers develop new methods for communicating Miranda Rights in a more effective manner to people that have limited language or cognitive skills.
Law	Researchers use knowledge of the variability of eyewitness testimony to develop training programs that teach police and other interrogators to get accurate

Field	Example
	information out of witnesses and criminals.
Literature	A researcher uses texts from the sixteenth century to understand the transition of essays as a genre from England to France during this time period.
Literature	A researcher conducts a phenomenological examination of reading, a philosophical examination of what people do and experience (from the perspective of their consciousness) when they read literature.
Literature	A researcher works with K-12 students to understand how to improve teaching literature to this group.
Literature	Researchers create digital, searchable archives of books from specific time periods and regions/languages to aid scholars of those time periods in finding necessary texts.
Materials Engineering	Researchers investigate how the degree of crystallinity in a polymer affects the properties of the material.
Materials Engineering	Researchers study the effect of changing a material's composition on the current-voltage curve upon exposure to solar energy to increase the efficiency of solar cells.
Materials Engineering	A company uses existing knowledge about a thin film material to develop increased impact resistant coatings for CDs, DVDs, and windshields.
Materials Engineering	A researcher explores the mechanical properties of materials by investigating the effect of the interatomic spacing of the atoms in a material on the bulk modulus of the material.
Materials Engineering	Researchers create a new hard coating for wear protection of computer hard drives by synthesizing a new material based on research into the connection between bulk modulus and interatomic spacing.
Materials Engineering	Researchers create new hard coatings that can be used for machining to reduce the use of lubricant.
Materials Engineering	A company applies a hard coating synthesized in the lab to disk drive manufacturing.
Materials Engineering	A company uses a high-temperature steel developed for buildings to build steam generators in a power plant, enabling higher operating temperatures and increased conversion efficiency.
Media and Communications	Library staff uses a technique called Livequal to administer an online survey to the user community to find out their opinion of the research library's staff, collection, and services.
Media and Communications	A research center conducts a study looking at data from 26 different news sites to see traffic patterns —who is coming to the sites and where they are coming from. The center is trying to understand the relationship between different patterns of engagement and where a person is coming from.
Media and Communications	A news organization commissions a series of surveys of the general public inquiring about their habits of news consumption to get a better understanding of the flow of local news to gain the widest audience possible.
Media and Communications	A university professor analyzes the role of social media in the development of a news story.
Media and Communications	Library staff digitizes a special collection of manuscripts and books.
Media and Communications	A research team designs new survey questions asking about respondents' news consumption patterns. The team looks at ways these questions have been asked in previous surveys and how people respond, analyzing for biases. They then create their own test surveys do get better understanding of any biases.
Medical Engineering	Researchers investigate the molecules and cells involved in the recognition and eventual rejection of foreign cells within a variety of animals' immune systems.

Field	Example
Medical Engineering	An engineer creates an in vivo tissue as a way to better mimic the in vivo state, allowing for the development of a greater understanding of the dynamic processes of that state and how other cells behave when placed in that environment.
Medical Engineering	Researchers measure the immune response of diabetic recipients to implanted Islet cells from cadaveric donors with the goal of reducing insulin dependence of diabetics.
Medical Engineering	A researcher investigates the changes a liver undergoes after being removed from the body to provide information that will be crucial in performing successful liver transplants in the future.
Medical Engineering	Investigators try to treat a disease in an individual by extracting the patient's blood, modifying it in ways unique to the patient, and returning it to the patient.
Medical Engineering	Researchers develop tissue chips that contain cells from a specific human organ and allow testing of the effect of drugs and toxins on human cells.
Medical Engineering	A researcher travels to a lab to learn a technique used in one type of research and then brings the technique back to the researcher's lab and applies it to their research in a new way.
Music	Researchers develop a transformational theory that provides a framework for understanding musical events not as a collection of objects that have particular relationships to each other but as a series of transformational operations applied to the basic material of the work.
Music	Researchers use historical records and the techniques of experimental archaeology to recreate the aulos (a type of flute used in Ancient Greece) to determine how it would have been constructed, how it was played, and the types of sounds it would have produced.
Music	Music educators and theorists work to produce new pedagogical materials based on new discoveries in neuroscience that change our understanding of how humans process sound and information.
Music	A composer develops a new conception of creating music by stringing discrete particles of sound together.
Music	Researchers study the way in which humans determine the direction and location of sounds to gain a better understanding of the role of acoustics in human perceptions of music.
Music	A researcher develops a visual programming language for producing electronic music and controlling musical and multimedia events.
Nanotechnology	Researchers study the electrical properties of graphene by using a scanning tunneling microscope to investigate how electrons move in the material in response to voltage changes.
Nanotechnology	Researchers use DNA to synthesize gold nanostructures in different shapes and then characterize the resulting structures.
Nanotechnology	Researchers investigate new material properties with the aim of making a smaller transistor.
Nanotechnology	Researchers study microwaves and thermal coupling with nanoparticles to properly align and sort carbon nanotubes.
Nanotechnology	Researchers use previous research on cold ionized atoms to develop an improved focused ion beam microscope.
Nanotechnology	Engineers use research in micro-manufacturing to develop a portable and modular micro-factory system with components that are each a key part of an assembly line.
Performing Arts	A choreographer works in a studio with dancers, experimenting with different dance forms.
Performing Arts	Researchers measure activity in creative districts and zones in neighborhoods and

Field	Example
	cities in the U.S.
Performing Arts	A director of theater facilitates a performance venue for artists to express themselves using the experimental body of research (such as dance forms) that they developed previously.
Performing Arts	Researchers use Bureau of Economic Analysis data to measure economic activity in art and art-related fields with the goal of quantifying the economic impact of the arts on GDP.
Performing Arts	Artists research, edit, and synthesize found material on an online citizen journalism project into a documentary theatre work with the goal of communicating the impact of war on veterans from the Afghanistan war.
Performing Arts	Researchers develop a technology platform, Tessitura, that improves how performance arts organizations do business.
Performing Arts	Researchers develop a story booth that uses audio and video recording technology to capture audience feedback about performances that they have just attended to improved the ability to measure the impact of the arts.
Performing Arts	Researchers develop a program that works with communities and young people to collect discarded wastes, such as plastics, and uses the waste to create original art works.
Philosophy	A philosopher investigates the basic assumptions underlying the concept of a photon though observations of and interviews with physicists studying quantum mechanics.
Philosophy	Philosophers question the assumptions about how animals perceive pain to inform veterinary experiments.
Philosophy	A team puts together a common framework to help different disciplines communicate with each other based on research on the fundamental differences between the fields. The goal is to facilitate interdisciplinary collaboration.
Physical Sciences (Astrophysics)	Researchers use the Atacama Large Millimeter/submillimeter Array (ALMA) to study a nearby young star and its orbiting rings.
Physical Sciences (Astrophysics)	Researchers examine the atmosphere of Venus to acquire knowledge of the greenhouse effect and possible tipping points for climate change on Earth.
Physical Sciences (Astrophysics)	Researchers apply knowledge of interferometry to create better telescopes.
Plant Sciences	Researchers investigate what genes are responsible for regulating photosynthesis in different forms of plant life.
Plant Sciences	Researchers investigate how the manipulation of crop genomes can increase the ability of crops to grow in low water or low nitrogen conditions.
Plant Sciences	Researchers incorporate known genes into another plant species to produce greater yields.
Political Science	Political scientists observe and analyze the results of electoral outcomes with respect to institutional structures.
Political Science	A political scientist creates a new way to conceptualize democracy on two dimensions to measure the level of democracy in communities and to understand why different configurations of democracy may lead to different political outcomes.
Political Science	A political scientist creates a new theorem, called the median voter theorem, which says that if a voting population evaluates a particular issue along a continuum with only one dimension (e.g., favorable to unfavorable), the preference of the median voter determines the outcome of the vote.

Field	Example
Political Science	A political scientist creates a counter argument to the median voter theorem, which shows that if voters evaluate an issue along two different dimensions, there can be no equilibrium and so the outcome of the vote is almost impossible to predict.
Political Science	Political scientists research how governments employ direct democracy with direct referendums on a ballot or employ representative democracy with a legislative amendment to get something done and look at the success or failure rates with respect to each type.
Political Science	Researchers investigate the connection between federalism and corruption. Theoretical work says that the federal system should be good at preventing corruption, but empirical evidence says the opposite. The empirical work identifies reasons for why the theory is invalid when applied to actual political behavior, which in turn can inform the use of different forms of governance when corruption is a concern.
Political Science	An investigator uses Bayesian forecasting models to predict electoral outcomes.
Political Science	A research team creates a computer program for political redistricting, which can design boundaries around populations with certain attributes. The software uses principles from political science to generate districts different from those produced by gerrymandering.
Political Science	A research team creates decision-making software that attempts to predict situations where interstate conflict and war will break out. The software is used by government agencies to forecast potential conflicts and address them proactively.
Psychology	Researchers conduct a study to understand how implicit (unconscious) biases influence social interactions.
Psychology	Researchers study whether there is utility in using analogies in STEM teaching, with the objective to optimize learning in STEM.
Psychology	Researchers develop books and tools using baby signs (a type of sign language babies can learn before they are able to speak) to market to families.
Religion	Researchers investigate the phenomenon of religious fundamentalism across a variety of cultures by examining its historical, sociological, anthropological, and political causes and consequences.
Religion	A researcher investigates the role of food in church social events to inform contemporary religious communities on their use of food in their fellowship.
Religion	Religious institutions use results from sociological studies (e.g., surveys) of attitudes of young people towards religion to create materials for outreach and methods of outreach to this audience, in an effort to reengage them in religious life.
Religion	Researchers conduct an in-depth study of a specific religious minority within the United States, to understand the size and characteristics of this community, including beliefs, practices, attitudes, social and political views, activities, and issues of self-identification.
Religion	Researchers at a religious university conduct research for a diocese to investigate the factors that influence church attendance.
Religion	Researchers examine the impact low response rates have on the interpretation of survey results, and how response rates affect study findings.
Social and Economic Geography	Researchers create GeoDa, a sophisticated spatial statistics software package, without any specific application in mind.
Social and Economic	Researchers seek to understand the fundamental dynamics of spatial interactions.

Field	Example
Geography	
Social and Economic Geography	Geographers and local planning authorities study how land use influences songbirds in Puget Sound for planning land use.
Social and Economic Geography	A research study analyzes the spatial-temporal patterns in the transmission and diffusion of an infectious disease outbreak.
Social and Economic Geography	Researchers model traffic behavior for transportation planning purposes.
Social and Economic Geography	A private company develops a new integrated system for tracking and recording the spatial and temporal data of entities as they move in real time.
Social Services Organizations	An organization fields a neighborhood survey that includes questions on food security with the aim of measuring the extent of food insecurity in the organization's service area. The goal of the survey is to inform the planning of a program to address this situation.
Social Services Organizations	A college access program yields mixed results on participant satisfaction surveys. Qualitative research with program graduates and teachers reveals problems in selecting appropriate participants and in how teachers modify the curriculum as a result. The program is altered to impose stricter guidelines on curriculum and course delivery, and to ensure that participants have appropriate preparation before entering the program.
Social Services Organizations	An organization gathers test score data for schools in its area from public sources to inform the development of its youth education program.
Social Services Organizations	An organization works with an external research group to conduct a five-year evaluation of a particular program. The project involves the use of randomized control trials to isolate the effect of the programs on participant outcomes, with annual data collection and analysis involving both current and past program participants. The findings are used by the organization to help it understand how the program produces specific positive outcomes, which then inform future program design.
Social Services Organizations	For one tutoring program implemented by an organization, extant research indicates that 50 sessions are required for a student to show meaningful improvement in school performance. The organization examines the influence of various factors, such as race and culture, on program outcomes. This investigation shows that such influences could change this minimum "dosage." Therefore, the organization is able to reduce the number of sessions per student, and finds that it can still achieve meaningful improvements in student performance.
Social Services Organizations	An organization is approached by an external group with a teen pregnancy prevention program, and is asked to implement and deliver that program in the organization's region. The external group provides the training on how to deliver the program, while the organization uses its knowledge of the community and the locale to determine how it should be modified to be appropriate for the target population.
Social Services Organizations	An organization's "theory of change" asserts, in part, that a child's home environment is a strong influence on academic performance. Therefore, the organization launches a program designed to provide parents with knowledge and tools for helping their children. The organization conducts careful pre- and post-intervention testing and measurement of program participants and uses the testing to investigate

Field	Example
	improvement in student performance attributable to the new program.
Social Services Organizations	An organization conducts research on its community to show that "food insecurity" is a problem in the neighborhood. The organization finds a novel program created by a community organization in the Midwest. The organization then conducts research and planning to determine how it could implement that program in its community. For example, it has to overcome the problem that there are no grocery stores in the area, so it explores bringing a mobile farmers market into the neighborhood once a week, or transporting community members to the closest supermarket.
Social Services Organizations	Several months after recipients of aid leave a non-profit program an expert follows up with studies that determine if the benefits from the non-profit's programs have persisted.
Social Services Organizations	An expert conducts a randomized control trial of a parenting intervention his organization has developed to address substance abuse by adolescents. To determine the efficacy of the intervention the control, standard intervention, and modified intervention groups are each given a survey before the intervention, after the intervention, one year after the end of the intervention, and two years after the intervention.
Social Services Organizations	Researchers conduct a longitudinal non-interventional study about a child's development. They gather information about a child from as wide a variety of sources of possible in an attempt to understand how environmental factors influence individuals.
Sociology	Researchers study whether the civil unrest in the Middle East came about as a direct result of government oppression or due to social movements that then led to government oppression.
Sociology	Researchers study how individuals' attributes are affected by their peers, using data from a survey of high school students from 12,000 high schools around the U.S.
Sociology	A researcher looks at the mismatch between Census tracts and school district boundaries in an effort to investigate the effect of the mismatch on funding for subsidized school lunches.
Sociology	Researchers conduct a proof of concept study of the social and emotional learning programming in eight different school districts.
Sociology	Researchers match different datasets across countries to come up with more useful and accurate indicators of disparity in effort to measure increases in disparity. The datasets tend to be complete in high-income countries, but poor quality in middle-income countries, so the team applies methods to account for this.
Sociology	A research center creates a new intervention aimed at promoting emotional and social competencies and reducing aggression and behavior problems in elementary school-aged children. This is then licensed to a publishing company that begins marketing it to school districts.