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ETHICS EDUCATION AND SCIENTIFIC AND ENGINEERING RESEARCH WORKSHOP

OUTREACH & ASSESSMENT

Despite significant and unprecedented scientific, engineering and technological advances as well as educational innovations in the past century, efforts directed toward training, outreach and assessment in a world which demands an increasingly complex set of ethical standards of conduct lag significantly behind.

In addressing issues of outreach in Ethics Training, one approach may be to consider the many parallels with 'knowledge management', i.e., developing an important and effective strategy of getting the right information to the appropriate audiences at the right time while assisting with dissemination and implementation – in ways that will ultimately improve performance as well as compliance with accepted standards. A wide variety of methods and approaches are currently in use. However, broad-based effectiveness remains undetermined as no systematic review has been undertaken or metrics developed to statistically determine need, reliability and validity to date. Existing assessment strategies seem to involve large-scale data mining strategies and longitudinal studies rather than scholarly approaches to establish efficacy and possible avenues for training intervention.

In order build and preserve the intellectual, research and practice infrastructure of the future scientific, engineering and academic enterprise, it is essential that exposure and adherence to ethical training, principles and standards be considered at the forefront of such efforts. Currently, the research enterprise has seen and benefitted greatly from increased public attention to a variety of ethical concerns. However, with continued advances in biotechnology and movement towards multidisciplinary and team approaches to research/professional practice, there are added challenges, concerns and complexities worth considering. Increasingly, government, industry and academia are joining forces in the "knowledge economy" with the expectation of leveraging for higher economic impact. In such scenarios, the Universities are becoming key components in the growth engines for innovation and economic success. Moreover, institutional administrators are being hired much more for fundraising and management capabilities rather than as research and education leaders. By default, such complex partnerships often give rise to additional practical ethical elements that eventually become retrospective concerns because they were overlooked at the formative stages. Among these are:

- Faculty/Institutional COI
  - **à** Role as an intellectual resource?
  - **à** Metrics to allow merit in promotion and tenure?
  - **à** Multiple/divided loyalties
- Intellectual property rights
- Information security
- Ownership and reward structure
  - o Technology licensing/revenues

As federal research funds continue to decline and Universities are forced to assume higher costs for (research) infrastructure, in the face of a growing 'need' for research, the potential for growing ethical concerns will continue to escalate. These concerns are compounded and exacerbated by the general view that money (research funding), the creation of new knowledge and its publication are the major accepted criteria for academic success. Also, in this era Tech transfer and Bio-Tech start-up, the increasing use of technology fosters not only high-

throughput studies and data production, but also increasing levels of information exchange and global collaborations. However, in this context, a typical research University wants more funding with fewer regulations. What are the 'best practices' in a cross-cultural or global realm? How do we ensure and validate shared governance, while maintaining credibility? How do we avoid redundancies?

While many institutions have been responsive to mandates driving the development of relevant policies and procedures, major research institutions have been largely oblivious to the training needs of an increasingly diverse academic environment and population. As such, if current trends and practices continue, significantly large segments of the future scientific workforce will not receive necessary or relevant training.

Future outreach and training efforts should therefore target all demographic groups at all levels of training within the academy: undergraduates, graduate students, postdoctoral fellows, faculty as well as research support and administrative staff. Although available materials and techniques vary widely and the level of effectiveness is yet to be systematically determined, many resources can be easily adopted and are readily transportable. However, there are no clear standards associated with resource development and/or dissemination. To date, the peer-based learning model seems to have found some momentum as an effective learning as well as outreach approach (For example, see University of Pittsburgh, Survival skills & Ethics Program). An additional approach worthy of consideration for the future may be to proffer mandatory training as part of the scientific/engineering degree curricula or syllabi. Regardless of the approach, the overarching outreach/training goals should be:

A. To achieve sustainable success by explicitly engaging and motivating all constituents.
B. To expand human capacity for ethical conduct in science and engineering research.

To begin to be effective, we must address the issue as to whether or not we are systematically transferring knowledge or information about Ethics training/knowledge acquisition to the next generation of scientists and engineers. To do so, it is imperative that future programs:

- **à** Expand 'Trainer of Trainers' capability.
- **à** Facilitate Benchmarking: finding, learning and adopting best practices.
- **à** Develop centralized information databases to encourage/facilitate 'knowledge transfer, sharing and implementation.
- **à** View Ethics knowledge as an asset and leverage it as product/service.
- **à** Identify challenges and barriers to training, implementation and knowledge sharing.
- **à** Assess the current culture; state of the environment.
- **à** Determine how leadership, existing (current) strategies and demographics impact practice, choices and information transfer initiatives.
- **à** Identify which approaches would be best - grand design or small scalable, progressive.
- **à** Develop plans to maximize existing resources.
- **à** Determine whether greater results may be achieved via coordinated governance or oversight.

Considerations must be given to measurement and assessment of outreach, implementation and knowledge transfer efficacy.

- What is the value-added?
- What are appropriate performance indicators or measurement criteria?
- What would be some key requirements?
- Are the concerns the same for research vs. teaching institutions?
- How will design facilitate enhancement and support of faculty/student performance?

Outcome measures should be established as specific learning tools, practices, resources and initiatives to foster long-term training and development of the next generation of scientists/engineers.

In an effort to effectively involve all levels of the scientific and engineering community in ethical conduct and professional practices, provide broad exposure and ensure long term sustainability, it is critical that teachers, students, scientists and the general public be continuously engaged as part of a comprehensive educational outreach program. With such approaches, all levels of academe as well as pipeline entities can be impacted, thereby contributing significantly to expansion and improvements in the current and future US science workforce and attaining the goals and mandates of the "America Competes Act."

In supporting a new vision for unified and sustainable ethical conduct and practices in research, it is critical to have the following key goals:

1. Develop and disseminate materials to promote broader understanding and appreciation for relevant issues – systematic approach at all levels – high school, college, etc.
2. Engage teachers, learners and professionals in activities to broaden/enhance ethics knowledge. This includes the establishment of key partnerships with professional organizations, etc.
3. Promote access/career training for diverse, under-represented groups; that is, to facilitate development of a pipeline path for scientifically literate students.
4. Increase public awareness of the real-life impacts of ethical conduct in science and real life.
    a. To sustain vision and demonstrate added value and credibility.
    b. Gain greater public understanding.
    c. Promote value of best practices in RCR to improving quality of Life Science and Engineering research and practice as well as impact on translational benefits.

Possible Actions Items:

1. To modify existing academic programs to accommodate technological advances to offer areas of emphasis in RCR and to address in comprehensive way.
2. Develop new or modify existing courses to provide required background **à** expertise acquisition (Train-the-trainer model).
3. Identify opportunities to access experiential training to reinforce and integrate relevant knowledge.
4. Develop opportunities for graduate students/post docs essential for future career success in academia, industry and research. Where do ethics come into play as a requirement?
5. Identify various methods/approaches to engage and/or facilitate buy-in at multiple levels. Consider involvement of accrediting bodies:
    i. SACS
    ii. Middle States
        - Require accrediting bodies to enforce/respond.
        - Degrees not awarded without ethics training.

Assessment

The assessment of outreach and training strategies and programs in research ethics can be potentially challenging. A key underlying reason is the general premise ad belief that many training programs exist as actual single or standalone activities or online courses. Accordingly, limited to no baseline information may be available. In addition, long-term follow-up is usually not possible or extremely limited as implementation of ethical 'best practices' in routine research

activities is generally not uniformed or may not even transcend the apparent great divide existing between classroom/training and the lab bench/practice.

Beyond the fundamental challenges stated above, assessment of outreach and training may best commence and proceed using small, scalable and progressive approaches. It is not only critical that the appropriate target groups are identified based on needs assessments, but that key benchmarks, goals and objectives be established prior to outreach activities. The necessary performance indicators and measurement criteria must also be clearly stated. Moreover, to effectively engage the scientific and engineering community, key resources and opportunities to access, reinforce and integrate relevant knowledge must be available and efficacy of outreach models or information delivery approaches clearly laid out. Overall, the validity and reliability of short- vs. long-term outreach/training goals must be specifically determined.