

# Physics Careers in Global Corporations

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# Outline: Developing Leadership Behaviors

- Milestones in a physics Ph.D. program
- Goals and Behaviors in Industry
- Model System for Leadership Behaviors
- Envision, Energize, Edge, Execute, Ethics (GE)
- Goals and Behaviors for Graduate Students
- Tasks for Grad Students to develop behaviors

# Milestones in a Typical Ph.D. program

Abstract ED01 (AAPT meeting 2011): Michael Dennin

**The graduate physics curriculum is pretty much the same everywhere, and has been that way since the 1950s.** The center pieces are courses in classical mechanics, electromagnetism, quantum mechanics, and statistical physics.

Though successful in training academic physicists, it is not necessarily the ideal curriculum for the cross-disciplinary nature of many current research areas or non-academic career paths.

# Milestones in our NMSU Ph.D. Program

- English language skills (international students):
  - Written test (can student write a thesis?)
  - **Oral test (can student teach a lab/recitation section?)**
- Core courses and electives (GPA>3.0)
- **Performance as a TA affects financial support.**
- Qualifying and comprehensive exams
- **Find an advisor who support the student (w/ RA)**
- Research, publications, conference presentations
- Thesis, defense
  
- **Most milestones are outcomes-based.**  
Behaviors don't matter much!

# Employment Statistics after Ph.D. (any field)

- Economist (12/16/2010 edition):

*The disposable academic*

## ***Why doing a PhD is often a waste of time***

- There is an oversupply of PhDs. Although a doctorate is designed as training for a job in academia, the number of PhD positions is unrelated to the number of job openings.
- **Only 16% of Ph.D.s become professors.**  
**What a waste!?!**
- In America only 57% of doctoral students will have a PhD ten years after their first date of enrollment. ... Poor supervision, bad job prospects or lack of money cause them to run out of steam.

# SILICON HILLS



# Where do Ph.D. physicists go in 2011?

- **Intel** to Build New Chip Plant in Oregon
  - The Intel Corporation said on Tuesday that it planned to invest \$6 billion to \$8 billion to upgrade manufacturing plants in the United States and build a new one in Oregon, adding as many as 1,000 new high-tech positions and thousand of construction jobs (NY Times, 10/20/2010)
- **Global Foundries** building new chip plant in Malta, NY, estimated cost \$5 billion. Hiring has already started and is ongoing.
- **IBM** advertises ~30 job openings for technicians, undergraduates, coops, and advanced degrees at their 300mm chip plant in East Fishkill, NY.
- Obama/Kyl agreement on New START treaty: \$81 billion dollars over ten years to be spent on modernizing the nuclear weapons complex.
- **Other industry sectors and government labs have similar needs for physics graduates in high-tech R&D and manufacturing.**
- **Factories are built in areas with good high-tech skill sets.**

# What products do Ph.D. physicists work on?

- Sugar bowl commercials:
- Smart cell phones
- High-speed mobile networks
- Car and truck engines
- Electric automobiles
- Remote-control cars
- Building a smarter planet  
(traffic control, tracking of food and drugs)
- Waiting for: **Planetary weather control ?**

# How should we prepare students for industrial careers ?

- Courses in other fields (electrical engineering, chemistry, IT, finance)  
Yes, but which one?
- Courses in accounting, management, law, etc?
- My opinion:
  - Careers take many twists and turns and are unpredictable **(NO PLAN)**.  
You may never need that **continuum mechanics** class etc.
  - Companies usually have “onboarding class” for new employees and management “boot camps” for new managers.
  - Presentation skills to non-experts in the field are crucial (TA skills!).
  - **Core expertise: Collection, analysis, and presentation of data.**
  - Personally, I find the Baldrige Quality criteria of Performance Excellence very useful (<http://quality.nist.gov>).

# Focus on the Customer: Performance Excellence

- “*Basic research is like shooting an arrow into the air and, where it lands, paint a target. Historically, university physics programs have done an outstanding job of teaching physicists to shoot, but not necessarily to aim.*”
- Federal funding agencies (like NSF) promote this culture of academic excellence.
- Industry is full of targets: “*Business plans, product performance specifications, project cost and timing goals, etc.*”
- Industrial physicists need to “*focus their efforts and creative skills to support known needs and existing commercialization plans. Directing arrows towards targets generally requires much greater breadth, persistence, and teamwork than shooting a new arrow in whatever direction one chooses.*”
- Sometimes, one needs to advance a certain subfield of physics to meet predefined goals (**innovation**), sometimes one needs a detailed understanding of a field developed many years ago (**reuse**).
- **Performance Excellence** is a formal process that describes how to paint, aim, and hit targets while making money in the process.

Source: Ken Hass, *Educating Physics for Industry*, Physics Today, December 2002.

# NIST Baldrige Award Criteria for Performance Excellence

- What are your organization's main **products and services**?
- How are they delivered to **customers**?
- What is your organization's culture (purpose, vision, mission, values)?
- What is your employee profile (education levels, workforce, diversity, bargaining units, use of contract employees, safety requirements)?
- What are your **major technologies, equipment, and facilities**?
- What is the **regulatory environment** under which your organization operates (occupational health and safety, accreditation requirements, environmental, financial, and product regulations)?
- What are your key customer groups and market segments?
- What are the key requirements for your products and services? How do these requirements differ among customer groups and market segments?
- What are your most important types of suppliers and dealers? Supply chain requirements?
- What are your key supplier and customer partnering relationships and communication mechanisms?
- What is your competitive position? What is your relative size and growth in your industry?
- How many competitors and what types of competitors do you have?
- **What are the principal factors that determine your success relative to your competitors?**
- What changes are taking place that affect your competitive situation?
- What are your key **strategic challenges** (operational, human resources, business, and global challenges)?

# Performance = Results + Behaviors

- **Results**
  - Describe the employee's contributions to the goals of the organization.
  - Based on SMART goals
- **Behaviors** (also called competencies)
  - Describe HOW the results were obtained

*If I meet my goals, why does it matter if I'm in a good mood or not?*

Baldrige winner states:

Our leaders are held accountable for both results and behaviors and we are driving this mental framework down through the rest of our population.

# SMART Goals

- **Specific and clear:**  
What to accomplish? Identify requirements and constraints.  
Who is involved? Where? When? With whom and for whom?  
*Join a health club and work out three days a week for an hour.*
- **Measurable:**  
Concrete criteria for measuring progress toward attainment of goals.  
Some goals or standards can be measured through **qualitative** means.  
The reader can tell that the results sought can be measured.  
Numbers or specific words to indicate success. Describe result, not activity.
- **Achievable:**  
Is it reasonable to expect meeting this goal? Do I have the skills and resources needed?
- **Relevant and result-focused:**  
What are we hoping to gain? Why am I doing this? What do we accomplish?  
Linkage to the goals of the organization (**balanced scorecard**)
- **Time-Bound:**  
Milestones with target dates (requires **project management**).

Example:

We will develop an InGaP-based heterojunction bipolar transistor with the following electrical characteristics (*insert here*), ready for customer sampling by (*insert date*).

**Obtain feedback on performance from internal and external work partners (Surveys).**

Source: M. Brounstein, Coaching and Mentoring for Dummies, IDG Books, Foster City, CA, 2000

# SMART Goals in our NMSU Physics Program

- English language skills (international students):
  - Written test (can student write a thesis?)
  - Oral test (can student teach a lab/recitation section?)
- Core courses and electives (**GPA>3.0**)
- Performance as a TA affects financial support.
- Qualifying and comprehensive exams (**2 attempts**)
- Find an advisor who can support the student (RA)
- Research, publications, conference presentations
- Thesis, defense
- **Time limit for financial support**
- **Most milestones are SMART goals**

# Leadership Behaviors (Competencies)

- **Decisiveness:** Takes **responsibility** for actions and decisions required
- **Conviction:** Demonstrates perseverance, displaying **confidence**
- **Knowledge:** Effectively uses the power that comes from **understanding**
- **Discipline:** Consistently **executes** as promised
- **Approachability:** Has **integrity**, and easily adapts to the styles of others
- **Clarity:** **Communicates** simply, clearly, and memorably
- **Direction:** Has, and expresses, clear **goals and vision**
- **Humility:** The ego is under control
- **Competence:** Demonstrates **skill**
- **Personal Energy (age discrimination?)**
- **Charisma: Likeable (measurable?)**

Not all behaviors (competencies) contribute to the success of an organization. Behaviors are chosen and defined carefully to be meaningful and measurable.

Source: [http://www.eaglesflight.com/leadership/10\\_qualities.html](http://www.eaglesflight.com/leadership/10_qualities.html).

See also Ken Hass, *Educating Physics for Industry*, Physics Today, December 2002.

Also: Pennsylvania State System of Higher Education.

# 5 E's of success (adopted from General Electric)

- **Envision:**  
Creates the future, imagines what's next.  
Thinks in terms of the big picture and how the pieces fit together.  
Comes up with the **vision, strategies, and viable plans** that turn a dream into reality.  
Questions assumptions and challenges conventional thinking.  
Generates breakthrough ideas that improve the way the organization operates.
- **Energize:**  
Creates energy among employees to work on projects.  
**Excites coworkers** around activities, projects, and events.  
Creates an atmosphere where everyone has passion to excel and opportunity to contribute.  
Sustains a **positive attitude in the face of difficult** challenges or adversity.
- **Edge:**  
Makes **tough decisions** when needed to achieve goals. Takes responsibility for problems.  
Convinces people to **collaborate**. Challenges people to do their best.  
Holds people accountable, takes action when their performance does not meet expectations.
- **Execute:**  
Completes projects on time and on budget. Meets **commitments** and keeps promises.  
Follows tasks/projects through to successful **completion**. Communicates about projects to ensure completion. Has strong **problem-solving skills**.
- **Ethics:**  
Professional integrity while working on projects. Is honest at all times.  
Builds personal credibility. Treats all people with respect and dignity (diversity)

Source: Chris Galvin Interview, Business Week Online, 17 April 2000.

Source: <http://www.public.asu.edu/~maxlev/DistrictPresident/AppendixC.htm> (KKΨ/TBΣ), 2/10/03.

# Ethics



# Measuring Behavior 1: Communication as an Example

- **Less than expected:**  
Verbal and/or written communication does not achieve an understanding.  
Style of relating to others is inappropriate and creates problems with peers, employees, and customers.  
Does not consistently treat others with dignity and respect.
- **Meets expectations:**  
Consistently maintains good working relationships with peers, supervisors, customers, stake holders, etc.  
Always treats others with dignity and respect.  
Willingly shares information that will enhance the work effectiveness of others.  
Promotes positive public relations and public image of organization.  
Strong written and verbal communication.
- **Exceeds expectations:**  
Meets all criteria under “meets expectations”. PLUS  
Shows talent in such areas as persuasion and conflict resolution.

**Behaviors are chosen and defined carefully to be meaningful and measurable.**

Source: Nebraska Health and Human Services System (web site).

## Measuring Behavior 2: Demonstrates Flexibility and Adaptability (Cooperation)

- **Less than expected:**  
Resistant to implementation of new approaches. Insufficient sensitivity to and does not show concern about impact of change on peers, employees, and customers. Indifferent to the effects of his/her behavior on others.
- **Meets expectations:**  
Takes proactive role in managing change. Sensitive to and shows concern about impact of change on others. Encourages trust and cooperation. Demonstrates flexibility in accepting additional responsibilities.
- **Exceeds expectations:**  
Meets all criteria under “meets expectations”. PLUS  
Viewed as a change agent. Personally works with others to implement change. Demonstrates flexibility in accepting additional responsibilities while maintaining current workload.

## Measuring Behavior 3: Fosters Diversity (Collaboration)

- **Less than expected:**  
Does not always recognize value of positive relationships with others. Does not value different opinions, experiences, backgrounds and/or cultures. Does not encourage diversity in composition of work teams. Withholds information and assistance.
- **Meets expectations:**  
Demonstrates a willingness and ability to work with others as team players in the pursuit of common goals. Encourages shared objectives with other workgroups. Values diverse opinions, experiences, backgrounds, and cultural styles. Encourages an environment of openness, trust and acceptance. Builds a participative environment.
- **Exceeds expectations:**  
Meets all criteria under “meets expectations”. PLUS  
Assures appropriate linkages between own work plans and organization goals. Facilitates a positive environment. Maintains a high level of morale.

## Measuring Behavior 4: Maintains Focus on Customer Service

- **Less than expected:**  
Not fully attuned to importance of customer. Does not appropriately participate in identifying customers' needs.
- **Meets expectations:**  
**Values customers. Consistently meets customers' needs.** Takes appropriate action to solve customer concerns effectively and efficiently.
- **Exceeds expectations:**  
Meets all criteria under "meets expectations". PLUS  
Assists others in developing the skills to provide quality customer service.

## Measuring Behavior 5: Job Knowledge and Productivity (Confidence)

- **Less than expected:**  
Focuses on responsibilities of others more often than own responsibilities. Sometimes fails to follow through on commitments. Demonstrates little or no initiative to acquire skills and knowledge necessary to meet requirements of position. Is not always completely honest or forthright. Work is not completed efficiently or of consistent high quality.
- **Meets expectations:**  
Takes **responsibility** for own actions and actions of workgroups. Works to solve problems. Shows initiative to increase job **knowledge**. Demonstrates honesty, integrity, and fairness. Effectively manages and maximizes talent of all employees; maintains a high morale within organization. Work output consistently meets quality and quantity standards for the position. Actively incorporates quality approaches to work.
- **Exceeds expectations:**  
Meets all criteria under "meets expectations". PLUS  
Demonstrates critically important knowledge that positively impacts results. Establishes a system of continuous improvement focused on improving work performance. Demonstrates very high levels of honesty, integrity, and fairness.

# Behaviors depend on Career Stage

- **Stage 1: Depending on Others** (junior engineer, technician)
  - Willingly accepts supervision and direction
  - Demonstrates success and competence on a portion of larger project or task
  - Masters detailed and routine tasks
  - Shows “directed” creativity and initiative
  - Performs well under time and budget pressure
  - Learns how “we” do things
- **Stage 2: Contributing Independently** (individual contributor, senior engineer)
  - Assumes responsibility for a definable portion of a project, area, or clients
  - Relies less on supervision; works independently and produces significant results
  - Increases in technical expertise and ability; develops his/her own resources to solving problems.
  - Demonstrates technical competence, credibility and a reputation for good work
  - Builds a strong internal network of relationships (collegial relations with coworkers)
- **Stage 3: Contributing through Others** (section manager, project leader)
  - Demonstrates a breadth of business AND technical expertise, perspective, and insight
  - Stimulates others through ideas and knowledge
  - Involved as a manager, mentor, or idea leader in developing and influencing others
  - Represents the organization effectively to clients and external groups (other work groups, senior management, industry associations, universities, government, etc)
  - Builds a strong internal and external network
- **Stage 4: Organizational Leadership** (department manager, director, VP)

Source: <http://www.btuweb.com/FourStagesOfCareerGrowth.asp>

# Behaviors can be overused

- **Personal Energy:**  
Creates stress for coworkers without clear purpose.  
Workaholic, does not take time for vacation or family.
- **Building Relationships:**  
Spends too much time and effort to build relationships with too many individuals and organizations that are not part of the work team.
- **Knowledge:**  
Is unable to communicate issues in simple terms to cross-disciplinary team.
- **Diversity:**  
Manages diversity of population based on quota, not on business needs.  
Overly concerned with personal differences, detrimental to team building.
- **Communication:**  
Sends five emails per day to the whole team about the status of the project.  
Unable to summarize, too much detail in reports.
- **Execution:**  
Plans every detail and never gets the work done.

# Behaviors for physics graduate students

- Behaviors are used to achieve goals.
- Define SMART goals!
  - Courses, exams, teaching, research
  - Hold students accountable for success or failure.
- Define behavioral standards! (4e+E will work)
- **Assign tasks to train behaviors:**
  - Teaching: Tardiness, recordkeeping, ethics, customer focus, communication, execution
  - Team teaching, team research
  - Interdisciplinary assignments
- Provide **feedback** on goals and **behaviors!**

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# Summary: Developing Leadership Behaviors

- Assessment: Milestones in a physics Ph.D. program
- Goals and Behaviors in Industry
- Model System for Leadership Behaviors
- Envision, Energize, Edge, Execute, Ethics (GE)
- Goals and Behaviors for Graduate Students
- Tasks for Grad Students to develop behaviors