
AC 2012-3016: ALIGNING INTERNSHIP, CO-OP, AND NEW GRADUATE ENGINEERING ROTATION PROGRAMS TO IMPROVE EXPERIENTIAL LEARNING

Mr. Eric Paul Pearson, Northrop Grumman Corporation

Eric Pearson is the Sector Director of Development Programs at the Electronic Systems Sector of Northrop Grumman Corporation. Pearson continues to develop new programs for recent college graduates in engineering across the United States, taking advantage of his broad background in engineering and education. Pearson's expertise stretches from earning a B.S. in K-12 Education, taught middle school science for two years, and coached soccer, swimming, basketball and lacrosse for more than 25 combined, with more than 25 years as a technical manager at Northrop Grumman, while completing an M.S. in engineering management. After a successful period leading the production transition of the Predator and the F-22 Raptor antenna programs as an RF Engineering Manager, Pearson returned to personnel management and leadership training program creation for early/mid-career employees. Pearson also serves as a volunteer on several boards of directors; Past-President for the Southern Association of Colleges and Employers (SoACE), Minority Engineering Advisory Board, and Electrical & Computer Engineering Advisory Board at North Carolina State University; and as a volunteer Adjunct Professor at California Polytechnic University in San Luis Obispo, Calif., where he works with several student groups and speaks in engineering classrooms. When not busy developing leadership programs or serving on volunteer boards, Pearson chases his passion for writing, having written and self-published *Ryan's Stories* "Gods Perfect Child," authored "A Common Sense Approach to Leadership," is currently writing a children's book titled, "Oliver Travels," and has two other genre books in development.

Mr. Timothy Boyd, Northrop Grumman Corporation

Timothy Allen Boyd's passion for baseball connected him to Northrop Grumman. It really worked in that order. After graduating from the California Institute of Technology in 2006, Boyd started working in Azusa, Calif., as a Systems Engineer on the SBIRS program (Space Based InfraRed System). Since 2006, Boyd has not only been involved in performance analysis and sensor characterization, with a number of technical publications featured in various conferences both internal and external to the company, such as CalCon and MD-SEA, but has also managed technical teams and is currently Deputy Integrated Project Team Lead within the SEIT (Systems Engineering Integration and Test) organization. Furthermore, to address his passion for leadership and community building, he kickstarted a chapter of ConnectING, a professionally recognized yet non-traditional development program focused on engaging and assimilating new employees to the workplace. He is currently one of three Western Region liaisons for the program. Boyd was also selected to be a part of the company's prestigious LTP (Leadership Training Program). He has risen in the ranks of LTP, and just two cycles from graduation, planned and facilitated the two most recent offsite retreats, events involving 100 participants, requiring months of detailed planning and acute project management. An avid nature lover, Boyd's hobbies include back country camping and hiking, as well as learning self-reliance in the wild. In his spare time, Boyd likes to cook, read, play the piano, and learn Urdu.

Aligning Internship, Co-op and New Graduate Engineering Rotation Programs to Improve Experiential Learning

Abstract

It has become extremely important that engineering students participate in relevant industry experience prior to graduation to become sufficiently qualified as the next generation of technological innovators. Through a structured development process aligning Internship, Co-op and New Graduate Engineering Programs within one organization, Northrop Grumman Corporation has been successful in providing significant relevant industry experience to current engineering students during their academic development periods while shortening the time a recent graduate in engineering is required to participate in a rotation program before feeling comfortable in becoming a long-term fixture in the organization. The Northrop Grumman Corporation has developed solid processes and continues to experience successful early integration of university engineering students into the organization who become; assimilated quicker, demonstrate a greater engagement than most recent graduates, and offer more productive experiences, while providing a significant advantage over other corporations in the hiring process. The integrated program satisfies both the student's and the corporation's desire to provide relevant experiences while offering the ability for students to "try out" the corporation and the corporation to "try-out" the engineering student prior to full-time consideration upon graduation from either an undergraduate or graduate engineering program.

To develop an integrated program that provides relevant work experiences while meeting customer and corporate goals, each of the integrated program elements must be; proposed and "sold" to the internal (hiring) organizations, be vetted as individual programs, and carefully aligned and integrated such that the organization embraces the structure and expenses involved in creating these early career development opportunities. The Development Programs Office has two customers in this scenario; the eventual hiring organization and the soon to be new graduate engineering student who will have multiple opportunities to select her 1st professional employment position upon graduation.

After having proposed, developed, vetted, piloted and integrated a successful Internship / Co-op/ and new graduate rotational program in engineering across the country at the Electronic Systems Sector of the Northrop Grumman Corporation, the push for constant evaluation and improvement continues. After three months of significant research and development Electronic Systems will be extending the Internship Program of the Integrated Experiential Learning Program within the Development Programs Office to allow for part-time year-round positions for local university students to supplement the permanent workforce during 10 – 14 week internships during the traditional academic sessions.

Aligning Internship, Co-op and New Graduate Engineering Rotation Programs to Improve Experiential Learning

We need not spend time quoting the research or documentation on the shortage of new graduate engineers available for the workforce in the United States. The concern is presented in every trade magazine today and great efforts and expense are being moved to foster new initiatives in STEM (Science, Technology, Engineering and Mathematics) education across the country. The topic has become one of a daily discussion as we read the statistics that 700,000 engineers are graduating every year from universities in China and India and only 70,000 graduating in the United States. Many U.S. Engineering Graduate Programs contain as high as an 80% International student enrollment in their engineering programs and there is currently a strong effort to encourage U.S. citizens to enroll in PhD programs, as well as an important push to encourage minorities to pursue advanced studies across all engineering disciplines. Local school systems from elementary through high school are rapidly adding science and engineering programs to their curriculum and seeking investments from the Federal Government and private industry partners to fund STEM Education in Math, Sciences and Engineering studies; so we can “catch up” to the competition. Investing in the future has always been a challenge we have faced and conquered in the United States as we continuously move forward with innovative ways to teach math and science such that young students will embrace the excitement of laboratory and other hand-on teaching methods in math and science; leading to their interest and pursuit of engineering as a career in the future. This paper will not discuss STEM Education or the many efforts being invested in to grow our engineers and scientist base of the future; rather it will present a solution to how one company manages to provide a cohesive and inclusive “development programs” structure including opportunities available during the engineering student’s college career leading to post-graduate options that not only provides significant “real world” experiences to complement the educational development afforded through the university system, but affords a set of experiences that is intended to; excite, engage, assimilate and retain the best engineers for a full and fruitful career within one corporation.

The Electronic Systems Sector of the Northrop Grumman Corporation rose from the depressed defense markets in 2001 about the same time the dot.com companies began their downturn. Engineers had been trained heavily in wireless communications technologies and software development areas of engineering. As a result of the dot.com crash due to loss of investment capital, it became necessary for talented engineers to turn to other industries to seek employment and therefore seeking a transition to more stable environments appeared to be prudent rather than continue to follow the teaching of professors and recommendations from parents. It was believed that the most talented engineering graduates should pursue opportunities where they can have exciting work, make sure they receive the highest possible entry salary and they should be prepared to change jobs every two to three years by leveraging the education and experiences to obtain greater

salaries and push the envelope of opportunities. No longer is the idea of working for one company 30+ years and drawing a retirement the scenario being taught. Rather, everyone has been trained to be prepared to work 7 to 15 jobs in one's set of multiple careers and jump at the opportunity to enhance one's income and personal development. If a management position doesn't happen fairly quickly, the new graduates quickly look for a growth opportunity with a consulting firm who is willing to pay engineers a premium to work in their industry.

Northrop Grumman made a conscious effort to research and evaluate the industry profiles and the students interests in an effort to determine what the engineering graduate of the 21st Century really wanted and realized that developing and implementing a program that would meet the expectations of the "new" college graduates was necessary to compete for the highest-potential talent and secure the innovators of the future. Therefore, based on a long-standing and highly successful "Grad Program" developed in the 1950s, Electronic Systems in Baltimore, Maryland conducted on campus interviews in addition to researching the development and leadership programs on Fortune 50 Companies such as Motorola, IBM, General Electric, Proctor & Gamble, and several Defense Electronic Companies to determine what developmental and leadership program elements had been proven to be consistently successful in the attraction, assimilation, development and retention of these most sought after high-potential engineering and scientific graduates. It was determined that graduates of the university systems were looking for some basic guarantees and opportunities:

1. Top salaries for engineers (competitive for market conditions)
2. Job security
3. Health and savings benefits
4. Work-life balance
5. Technical challenges and growth opportunities
6. Leadership development programs
7. A constant learning and growth environment
8. Mentoring for technical, management, and career advice
9. Community service programs
10. Opportunities to lead early in one's career
11. Tuition reimbursement programs for advanced degree pursuit (MS and MBA)

The recent graduate from the university setting today has great expectations centered on self, concentrating on personal growth and development, while affording free time to pursue outside activities and enjoy life away from work. This generation works to play while Generation X lived to work. The thought that working for one corporation one's entire career isn't in the vocabulary of more than a few of today's graduate. We determined it would be necessary to develop a program that satisfied as many of the guarantees desired by the graduates while at the same time meet the business goals of the corporation.

Some of the programs investigated (all highly successful programs) offered Leadership Training Programs for new graduates as part of that first job with the company, requiring six month to a year

in one location and forced relocation during a two to three years development program cycle. Other programs provided technical development opportunities where the recent graduate would work a set period of performance in one development area and then be transferred to another location / position for additional development. As much as these programs seemed to work, there were considerations of the programs that seemed to be missing a level of flexibility today's graduate desires in her personal development plan and they limited the choices the individual was allowed to make on her own. Today's talented graduate has many choices where to work and through social media keeps track of opportunities and where technology is leading them to the next great opportunity. We are all competing for a limited supply of high talented engineering graduates across many industries.

Taking the desires of the graduating engineers into consideration, in 2002 Electronic Systems embarked on the creation of a New Graduate Professional Development Program for recent college graduates titled, "New Graduate Engineering, Manufacturing & Logistics Professional Development Program (PDP)". The idea was to develop an expansion of a former and successful program designed to offer graduates a rotational program that satisfies many of the desires of the new employee while meeting the goals and objectives of the corporation. The development of the program was not instantaneous and it continues today as an evolving program providing annual evaluation, participant surveys, feedback sessions, continuous process improvement plans, and growth of participation from across additional corporate campuses and disciplines within and outside of engineering. The initial program was designed to offer recent engineering graduates rotational assignments starting every 3-4 month for a total period of 12 – 18 months where upon the conclusion of the program cycle the "seasoned" graduate would choose one of the previously experienced assignment areas and "go permanent" in that organization. The initial assignments were limited to engineering design and manufacturing departments in the Electronic Systems Sectors at the Baltimore, Maryland location.

The rotational assignments in the Professional Development Program were traditional design support opportunities in:

1. Hardware,
2. Software,
3. Systems,
4. Manufacturing.

Most of the participants had completed one of the following degrees:

1. Electrical Engineering,
2. Mechanical Engineering,
3. Computer Engineering,
4. Software Engineering / Computer Science,
5. Material Science & Engineering, or
6. Industrial Engineering.

One of the early program changes was the inclusion of more engineering / scientific disciplines to balance the capabilities of the recent graduates entering the rotational program, and to meet the changing requirements of all projects across a wider scope of technologies and responsibilities. The program quickly expanded to include the following degree concentrations;

1. Applied Math,
2. Computational Electromagnetics,
3. Operations Research,
4. Manufacturing Engineering,
5. Engineering Technology,
6. Physics,
7. Chemistry,
8. Textile engineering.

Another key elemental change to the new graduate professional development program structure, that has been one of the most successful advancements in the program, is the inclusion of non-traditional participants. Non -traditional in that most rotational programs hire only new graduates fresh out of school; after the standard four or five years of study with limited work experience through summer internships and co-ops. In 2003 the New Graduate Professional Development Program hiring profile included approximately 40% of its participants entering the workforce a Masters in Engineering and a few with an MBA or MS in Technical Management. We began interviewing and hiring PhDs in Electrical Engineering and other non-traditional students who had returned to the university setting to pursue a Master's of Science in Engineering after as many as seven years in industry; post Bachelor's degree. This decision to include a wider range of disciplines in the program not only provided greater variety of backgrounds in the program, it added an element of diversity that had not existed previous. Suddenly we had more experienced recent graduates, who were more mature than the rest of the entry level team, had extensive relevant work experiences, even though most were new to the defense electronics industry. The blend of educational backgrounds and experience levels provided a cross-discipline transfer of knowledge that was unexpected from the program. These early successes have led to a more inclusive selection process allowing the program to rapidly grow and expand over the past ten years.

Because of the diversity of thought injected into the program and having provided what the engineering college graduate is seeking, the program has also become an environment where the recent new graduate population is beginning to match the diversity of society. Over the past eight years of the program, almost 30% of the recent college graduate hires have been women and 52% have been "people of color" and women.

Studies of Change

Between 2000 and 2003, one area the rotational program was struggling was manufacturing. It seemed that the strongest of the recent hires were constantly being placed in hardware and software

design positions, while the graduates with limited or no work experiences were placed in manufacturing with the intent to introduce an understanding of products and services developing the ability to manage data analysis and manufacturing process flows. This practice had unintentionally caused an imbalance in depth of engineering talent across all organizations and created a belief that manufacturing engineers were not as knowledgeable as the design engineer. It seemed the historical practice was that the design engineer would complete his design, develop breadboards and demonstration models in the lab, and then “toss it over the fence” to manufacturing where often all hell broke loose because the design could not be manufactured; or pass production test requirements. Not including manufacturing in on the front end of design and test development caused many designs to be un-manufactureable, created much finger-pointing and resulted in many unplanned and unfunded redesign struggles during fixed-price production contracts. The design engineers would tell the manufacturing engineers they weren’t smart enough to assist in the design and ignored manufacturing input. The manufacturing organization was struggling with the design teams and weren’t deep enough with the experience levels of the new graduates being assigned to their operations. The rotational program began assigning the most experienced and capable new graduate engineers to manufacturing for their first rotation which resulted in great results; in addition to hiring graduate engineers with prior experience in other manufacturing industries. We began hiring high-talent masters’ degree graduates in Operations Research into the development program. This helped stem the practice of “tossing the design over the fence” and manufacturing engineers became included up front during the design and development phases of new contracts. Quickly the manufacturing organization began asking for new graduates to work in their area where in the past they had refused to accept the untested engineers because in the past they were thought to be less adequate engineers. Through a targeted change to balance the talents, skills and experiences of the multi-disciplinary engineers across organizations we have become a more diverse and successful engineering entity and the need for experienced contract engineers to fill entry level positions has virtually disappeared.

This change in approach to rotations in the manufacturing organization is one of many unplanned success stories that have been realized through a flexible program rather than modeling it after the more rigid programs previously researched. An innovative experiment that was implemented in 2003 was to hire a part-time PhD graduate into the rotation program and place her in the digital design organization where she would work twenty hours a week while raising two small children at home. Not only was this our first part-time member of the rotational program, it was our first PhD in the program. Previous to the changes implemented during 2002 and 2003, the general consensus (opinion of course) was that a PhD graduate would bring too much knowledge and experience to the new graduate program, not want to participate, and that a part-time employee would not be able to complete significant work to be of value to the organization. We chose to tackle both opportunities at the same time. Our first experience proved to be highly successful and the woman who accepted this challenge in 2003 is still working part-time in our organization and has won national awards as “Black Engineer of the Year” and “Women Of Color” in Engineering awards. The success of creating and maintaining a flexible program continue to reap great rewards. In her spare time, this

talented woman mentors other young diversity engineers in our workforce, continuing our efforts to provide the best working relationships and environment for a growing diverse population.

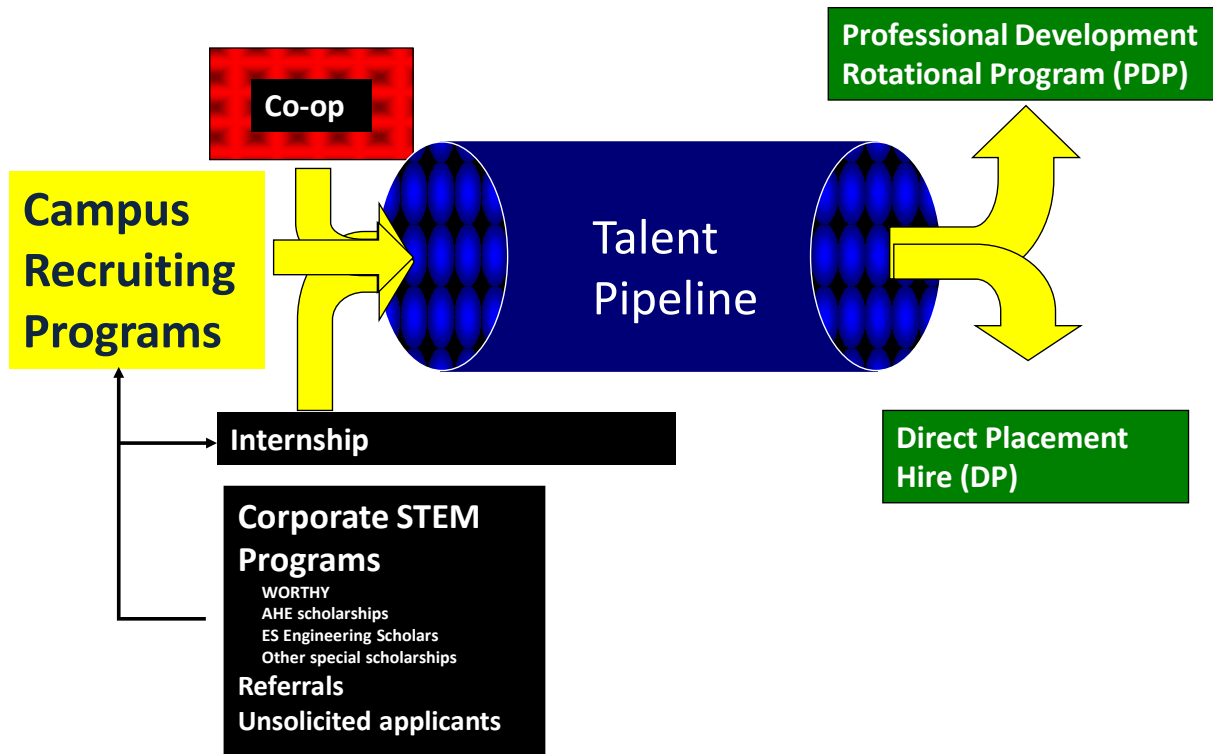
Creating the Pipeline for the Future of Engineering

Those of us who have been around the past thirty or so years have experienced the ups and down of engineering opportunities across all industries. One year, we find that chemical engineers are able to demand salaries 20-30% higher than all other engineering disciplines and suddenly two years later, chemical engineers can't find a job coming right out of school. To be successful in pursuing a balance between the demands on the industry to perform with the available talent, corporations must establish and maintain a structured and successful pipeline of talent that is flexible enough to turn on and off the spigot whenever the industry needs to grow or shrink its talent base. Another consideration is also important; developing the academic talent by supplementing classroom studies with relevant industry experience through co-ops and internships. These balances through the structured process provide a branding mechanism for the corporation often called "try us out" opportunities.

After creating the flexible and successful new graduate rotation program in engineering and manufacturing, Electronic Systems embarked on expanding the program through a plan to integrate current college students in complementary programs that directly align and report within the existing new graduate rotational program. Prior to the past two years, there had been internships and limited co-op opportunities across the organization, which operated with limited oversight and were not always staffed with strategic participants or provided relevant engineering assignments. There was minimal guidance as to responsibilities of the intern or the assignment manager. Some opportunities worked out extremely well while others operated with limited oversight and no performance feedback. There was little integration of the interns and co-ops into the general workforce and they were not included in employee activities. It had become hit-or-miss whether an assignment was effective, whether the student had an enjoyable learning experience, or the company received valuable productive benefit from some of the internship assignments. By aligning the internship / co-op program into the structure of the New Graduate Rotational Program, a process was developed and general oversight transferred to the Development Programs Office where all participants became an integral member of the organization and received consistent and increased opportunities across the organization.

Since the initial transition of the Internship Program to become a functional element of the Engineering / Manufacturing & Logistics Development Programs Office, the Cooperative Education Program as well as feeder programs have been aligned to ensure all investments in future engineers are captured within one program oversight and all candidates are given equal consideration for positions that become available in the Internship, Co-op and New Graduate Rotational Program. The feeder programs afforded to our future engineering, technical and business leaders include the following groups as depicted on the attached diagram; "Aligning Internship, Co-op and New Graduate Engineering Rotation Programs to Improve Experiential Learning".

Aligning Internship, Co-op and New Graduate Engineering Rotation Programs to Improve Experiential Learning



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All interns, co-ops, and new graduate hires now report to the same management structure and follow a consistent set of policies and procedures from application, to interview, to selection, assignment monitoring, evaluation and critical feedback at the end of the assignment / rotation.

Elements of the Engineering Internship Program

1. 8-10 week summer assignment,
2. Assignment within relevant engineering disciplines,
3. Rising Junior, Senior or Graduate student,
4. Minimum 3.2 G.P.A. in Major,
5. Assigned Navigator and mentor during work experience,
6. Must apply online and be selected through standard process,
7. Completed Performance Goals & Objectives at beginning of assignment,
8. Completes Performance review and evaluation at end of assignment,
9. Is given priority consideration to return or full-time position upon graduation if qualified,
10. Participates in "all-hands" meetings with permanent employees,

11. Participates in all planned social events,
12. Allowed to participate in sports leagues and company community service events, and
13. May join and participate in Employee Resource Groups (ERGs) during employment.

Elements of the Engineering Co-op Program

1. Preferred back-to-back sessions; Spring / Summer, Summer Fall participation,
2. Assignment within relevant engineering discipline,
3. Rising Sophomore, Junior or Senior,
4. Minimum 3.2 G.P.A.,
5. Assigned Navigator and mentor during work experience,
6. Must apply online and be selected through standard process (may be facilitated through university Co-op office),
7. Completed Performance Goals & Objectives at beginning of assignment,
8. Completes Performance review and evaluation at end of assignment,
9. Personal interview conducted at end of Co-op experience for further interest discussion,
10. Is given priority consideration to return or full-time position upon graduation if qualified,
11. Participates in "all-hands" meetings with permanent employees,
12. Participates in all planned social events,
13. Allowed to participate in sports leagues and company community service events, and
14. May join and participate in Employee Resource Groups (ERGs) during employment.

Elements of the New Graduate Engineering Rotational Program

1. BS / MS & PhD recent graduates; preferred relevant work experience,
2. Program duration 12 – 18 months,
3. Number of assignment rotations recommended during program is 3 -5,
4. Assignment rotations span 3-6 months,
5. Assigned a Navigator Mentor,
6. Provided tools and training for professional development,
7. Reports to a personnel manager and assignment manager,
8. Completed Performance Goals & Objectives at beginning of assignment,
9. Completes Performance review and evaluation at end of assignment,
10. Evaluated annually for raise and promotion consideration,
11. Participates in "all-hands" meetings with permanent employees,
12. Participates in all planned social events,
13. Tuition reimbursement program for appropriate advanced degree pursuit,
14. Allowed to participate in sports leagues and company community service events, and
15. Encouraged to join and participate in Employee Resource Groups (ERGs) during employment.

Extended Internship Program

With the recent success of internships as opportunities to fill short-term needs during the summer and a high conversion rate of interns upon graduation, the organization has decided to establish an extended Internship Program as pilot opportunities throughout the college term; semesters for some and quarters for others. To ensure proper alignment and buy-in from the hiring organizations, a three month research study was completed that evaluated the historical structure and success of past internship programs, grad-program elements, and sector policies and procedures. It was determined to conduct interviews with departments that would be providing the in-semester internships to be an important inclusion technique in selling the program idea. The Electronic Systems Sector has a long history of development programs and evaluating past successes and struggles is important in the development of the new extended internship program. Two important elements of an extended internship program process definition were determined to be the need to set standard policies on period of performance, entry level qualifications and open communication across all organizations; to ensure complete understanding of the new policies being implemented. This is important in having a transparent selection and inclusion process in recruiting and staffing limited number of in-semester internship opportunities. The most important factor to consider is to ensure that there is a quick and equitable process in place for determining short-term opportunities within the organization where local college students would be recruited to fill the open positions and future talent evaluation processes were embedded in the structure.

As is standard process for each of the other development program elements, these in-semester interns would be assigned legitimate work responsibilities, be required to develop a set of performance goals with their assignment manager and complete an end of term assessment evaluation. The need for additional project support and the student's performance will be the determining factors as to whether the intern continues through the next semester or offered permanent employment upon graduation.

The extended internship program provides an additional opportunity for;

1. Students to gain relevant engineering experiences,
2. Students to learn to balance work and school,
3. Students to earn competitive salaries,
4. The organization additional opportunities to evaluate future full-time candidates,
5. The organization to hire short-term employees throughout the year, and
6. The organization to brand itself with local universities.

Additional Advantages of a Development Programs Structure

When opportunities exist, participants in the rotation program may choose to accept rotations at other Sector locations. This requires that there be a match between skills and needs, a minimum of six months of productive funding, flexibility by the participant to relocate at minimum expense, and affordability within the receiving organization to cover the additional expenses of a relocation. The

engineering and manufacturing organization found it was important to have the temporary assignments at other locations be a mutually agreed to arrangement. We realized that forced rotations on both the individual and the organization posed too many barriers to be effective. By requiring volunteer participation, the creation of opportunities occurs smoothly and the employees tend to volunteer, knowing they have a finite period of performance with the guarantee they can return to their home base. The program has been extremely successful since its inception in 2003 such that 50% of those who accepted temporary relocation assignments across the country remained at the new location and have become permanent fixtures and highly productive employees at their new home.

To create effective cross-campus rotation assignments it was important to ensure affordability. After four years of negotiations and collaboration the Development Programs Office established a modified Field-Engineering Services Field Assignment Data Letter (FADL) to be used for these short-term cross-campus assignments. The modified policy is known as Lite-FADL. Key elements of the new policy are;

1. Prearranged temporary housing,
2. Automobile lease for “period of performance”,
3. Defined relocation expense limits,
4. Elimination of daily meal, laundry and gasoline payments,
5. Elimination of assignment completion bonus, and
6. Elimination of bi-monthly travel to home base coverage.

To evaluate the policy changes, I required significant time and partnership buy-in at locations across the country. It was important to evaluate and understand the legal aspects regarding tax implications as well as period of performance limitations to ensure that an equitable policy was developed. In addition, it was important to communicate across all organizations as well as to prospective program participants that the program was one of choice and affordability, and that limiting the extra payments afforded to field engineering employees on temporary assignment was a necessary change.

The alignment of the Internship and Cooperative Educational Programs with the New Graduate Rotational Program offers an affordable and consistent set of processes to ensure all candidates are given proper consideration and timely evaluation of their application and placement in appropriate positions within the organization. There are a number of legal as well as philosophical considerations that can become clouded in programs where separate groups / organizations are allowed to control their own selection and implementation processes. By bringing all candidates through one organization’s approved set of process steps, the challenges to those chosen to participate in internships, co-ops and new graduate hires have diminished significantly. It also provided a documentation of record in the case that the program was challenged or audited or participant selection become a concern.

Another, and perhaps equal, consideration in having an aligned program selection and guiding oversight process is the importance of developing the best opportunities to screen candidates prior to a permanent hire position. Across the defense industry, it costs approximately \$45,000 in recruiting expenses to find and replace an employee who has chosen to leave the organization. These expenses include; job postings, recruiting, interviewing, site visits, house hunting trips, temporary living expenses and household relocation costs; often for less than five years of experience positions. When an organization provides relevant internships and co-op experiences for high-talent candidates it creates the “try us out” situation. This is not only an opportunity to evaluate if the corporation will provide the challenging assignments for the undergraduate candidate, it also creates a chance for the corporation to test their ability to provide growth and development opportunities for the students, prior to making a permanent offer upon graduation. Despite having multiple levels of screening and interviewing, it is difficult to evaluate the performance capabilities or desire of a student who presents a high level of potential. The periods of internships and co-ops provide both the student and the corporation a period of evaluation.

Potential versus Performance – Key to Successful Selection of Long-term Employees

Key attributes of long-term, highly engaged employees are the ability to recognize potential and drive performance. One can see potential in a resume and through an interview. Only through performance evaluation during relevant work experience will the complete evaluation occur, predicting future success.

POTENTIAL can be expressed as (in engineering terms)

The electric potential at a point \mathbf{r} in a static electric field \mathbf{E} is given by the line integral and can be evaluated through review of résumés, personal interviews and professor recommendations.

PERFORMANCE is defined as:

“The accomplishment of a given task measured against preset known standards of accuracy, completeness, cost, and speed; or is deemed to be the fulfillment of an obligation, in a manner that releases the performer from all liabilities under a contract.”

Through the elements of a development programs structure; internships, co-op, recent graduate rotation programs, the corporation is interested in evaluating several factors of the potential full-time employee:

1. Technical understanding of basic engineering skills,
2. Team work interest and performance,
3. Interest in the company's technology,
4. How the candidate fits in the culture,
5. Growth and development (potential versus performance),
6. Future potential and high-potential interest,
7. Leadership skills.

The Internship / Co-op participant is interested in evaluating several factors of future full-time employment:

1. Technical challenges,
2. Corporate culture,
3. Teamwork versus individual contributor opportunities,
4. Personal, professional and leadership growth opportunities,
5. Work-life balance considerations,
6. Salary & benefits,
7. Social and volunteer opportunities,
8. Climate and recreational outlets.

During the period(s) of one's internship or co-op experience, a participant is able to evaluate his/her interest and fit within the organization for long-term employment consideration. The generally accepted term of employment for a recent graduate in engineering is two years prior to picking up and moving on to another company for the next two years. Through the development of a New Graduate Development Rotational Program, and an alignment of the internship and co-op programs, Northrop Grumman Corporation has seen a significant decrease in the number of recent graduates who resign and move on after 2-3 years of employment. Instead, we are seeing employees stay 5-8 years before we begin to see a percentage of the organization leave for other opportunities. The longer we can keep them past the five-year mark, the more likely the fairly recent new grad will stay 10 – 15 years, with the desire that they remain for a 30 – 40 year career contributing at the highest level of engagement possible.

SUMMARY

The Electronic Systems Sector of Northrop Grumman Corporation aligned the Internship, Cooperative Education and New Graduate Rotation Program under one organization, the Development Programs Office. This office established one set of policies and procedures intended to effectively balance the needs of the organization by integrating the development of engineers with the desire to provide relevant industry experience for engineering students during their final years of undergraduate and graduate studies, as well as during the early years of their careers. Through the research of programs across the industry and from previous positive success with existing programs,

Electronic Systems embarked on a growth and expansion study to align multiple elements of developing engineers into the workforce.

The growth and development has led to a well aligned and successful program supporting the engineering students during their years of study during internship and co-op periods of performance, integrating them with recent graduate members of the new graduate rotation program as fully integrated members of the organization during their period of performance. It was important to provide each participant with experiences in engineering as well as experiences as an employee of an organization to develop the desire and passion for engineering and personally develop one's approach to a future in engineering.

The success of the program alignment described in this paper was based on thorough research, involved educating policies and procedures to partnering organizations, was facilitated through communication of policies and procedures to hiring departments and university partners, and required developing consistent communication as to the value and purpose of the newly aligned internship, co-op and new graduate rotation programs. The alignment offered an understandable and inclusive set of processes and oversight which meet the objectives and needs of the hiring organizations and the student engineers; designed to facilitate experiential opportunities and placement of the most qualified students throughout the organization. The organization has realized a more efficient program operation through the alignment of the separate programs under one leadership. It has created an efficient, inclusive, equitable means for talented engineering students to experience relevant industry assignments leading to personal growth and development while "trying out" an organization for future full-time employment. We desire to help students grow and learn while contributing to the success of the organization no matter whether they are participating in and internship, a co-op, or a new graduate professional development rotation program.