INTERNATIONAL ASTRONAUTICAL FEDERATION

International Programme / Project Management Committee

IAF-IPMC Young Professionals Workshop

20 September 2013 – Beijing, China

Report

Group photo of the 2013 International Project Management Committee Young Professionals Workshop delegates on September 20, 2013.

Contents

1 Executive Summary

On September 20, 2013, more than 40 young professionals from government, academia, and industry came together from around the world to engage in a workshop about their future careers. Delegates participated in pre-workshop sessions through Skype and teleconferences, and collaborated through a Facebook group before attending the workshop, which was held in Beijing, China just before the 2013 International Astronautical Congress (IAC).

Organised by the International Programme/Project Management Committee (IPMC) of the International Astronautical Federation (IAF), the workshop focused on mentoring programmes, exchange assignments, on the side projects, tools and methodologies for project organization, and knowledge exchange and networking. Workshop delegates shared stories, insights, and data about their work experiences and developed recommendations for these topics.

The results and recommendations from these discussions will help the IPMC, the IAF's member organizations, and the workshop participants to consider what today's space organisations can do to develop and empower the workforce of tomorrow.

2 Background

In response to the widening aerospace workforce generational gap, the International Programme/Project Management Committee (IPMC) wished to dedicate its attention to issues pertaining to the young professional community. In order to better understand how their committee might address the needs of this community, the IPMC member organisations agreed to support a workshop for young professionals. An Organizing Committee of young professionals was selected to plan and organise the event. The resulting IPMC Young Professionals Workshop sought to gather the input of young professionals in the international space community to provide the IPMC with the knowledge needed to better develop and empower the next generation workforce.

The workshop attracted over 40 young professionals, typically defined as being age 35 and younger, from government, industry, and academic aerospace institutions from all over the world. Together they discussed five topics of interest to the IPMC: mentoring programmes, exchange assignments, on the side projects, tools and methodologies for project organization, and knowledge exchange and networking.

The full-day workshop occurred on Friday, September 20, 2013 at the Grand Skylight Catic Hotel in Beijing, China, where the workshop delegates participated in active discussions about their topics, produced a brief presentation to summarise their findings, and participated in a discussion panel to close the event. This report presents the observations and findings of the IPMC YP Workshop.

3   Virtual Session Collaboration

Since the workshop was a one-day event, the Organising Committee felt it was necessary to establish foundational relationships among the delegates who would attend through virtual means. With a globally distributed, diverse group, the Organising Committee elected to employ online social and collaborative tools, such as Videoconferencing and online collaborative documents, to facilitate "breaking the ice" and initiate group conversations around the chosen discussion topics.

After the delegates were selected, the Organising Committee administered a survey to obtain information for the workshop handbook and their preferred workshop topics. This information helped split the delegates in groups and invite them to a private Facebook Group to begin initial discussions.

In addition to the Facebook group, the Organising Committee scheduled at least one virtual session per group through video or teleconference. Each group had a leader to facilitate and guide the discussion. At least one Organising Committee member attended each conversation in a supportive role. It is important to note that not all participants had access to certain online tools (e.g. Skype) due to restrictions on their work computers.

Overall, the sessions worked well as a means to bring the delegates together prior to meeting in person at the workshop. It was an effective exercise that enhanced the overall workshop experience.

4   Group Discussion and Findings

4.1   Topic 1 – Mentoring and Shadowing Programmes
"What mentorship and shadowing programmes exist in different organisations in the space sector?"

4.1.1   Introduction

Mentoring can be broadly defined as a professional relationship between a senior member of an organization and a younger, less experienced employee for the purpose of career development and knowledge transfer. Mentoring represents one way to address the age gap facing the aerospace and defence industry, enable young professionals to take on increased responsibility, and accelerate the integration of a new employee into an organization. The mentoring working group for the IPMC workshop set out to conduct a survey of established mentorship programs across the aerospace industry, identify the benefits of mentoring programs from the perspective of both the organization and the participating employees, and provide recommendations for fostering an environment that is conducive to mentorship.

4.1.2   Benefits of Mentorship Programs

Many aerospace organizations, from very small (<50 employees) to very large (>20,000 employees) have some type of formal mentorship program. The primary purpose of these programs is to address the critical age gap in the aerospace industry – as more senior members of an organization retire, it is essential to ensure that their knowledge is effectively transferred to the younger employees who will carry on their work. According to the Aviation Week 2013 survey of the US aerospace and defence sector, approximately 10% of the aerospace workforce is currently eligible for retirement and that number will only increase as the "baby boomer" generation approaches retirement age. Other countries face similar challenges in their A&D workforce. Compared to the era when their older counterparts entered the workforce, today's aerospace employees are much more likely to transfer between several companies during the course of their career, further complicating the issue of knowledge management.

The benefits of a mentorship program from an organizational perspective are many. Well-established mentorship programs generally render the organization more attractive to potential employees, who may feel participation in such programs will accelerate their learning process and enable them to make significant contributions to projects and/or assume leadership roles within a shorter time span. As previously discussed, mentoring improves knowledge management and in particular can help ensure the preservation of "tribal knowledge" not formally documented in organization reports and procedures. Mentorship programs can also function as a mechanism for talent identification – if a mentor drawn from a higher level in the company sees significant potential or talent in a mentee, the mentor may be in a position (assuming the employee's supervisor is cooperative) to give the mentee an opportunity to work on higher level/flagship projects in some capacity, even if the project lies outside the scope of the employee's regular job duties. In general, mentoring offers a more personal approach to training and career development that is attractive to new employees who may initially feel "lost" in a large

organization. The success of a mentoring program can be measured in terms of both knowledge transfer and employee retention. Our initial survey results indicated that a relationship with a mentor can impact an employee's choice to remain with an organization in the long-term, as 30% of survey respondents reported that a lack of a mentoring relationship had strongly influenced their decision to leave an organization.

The mentor can also derive significant benefits from a professional relationship with a younger employee, including personal satisfaction from successes of the mentee. Reverse mentoring relationships enable more senior employees to take advantage of fresh perspectives and approaches to doing business that new talent often bring to an organization.

4.1.3   Informal vs. Formal Mentoring

A variety of formal mentorship programs exist in the aerospace sector. In most programs, an incoming employee is assigned to an more senior individual who provides informal guidance and advice to the mentee as he or she transitions into the organization. In this context, a mentor has a role that is distinct from that of a supervisor or manager – the mentor is not responsible for directly monitoring or evaluating the employee's work, although he or she may offer constructive feedback and/or facilitate additional learning opportunities. The advantage of formal programs (where mentors are assigned and regular meetings between participants are required) is that they offer a clear understanding of expectations and roles. Associated documentation (individual development plans which the mentor helps the mentee to write, for example) can be used to create metrics and evaluate the effectiveness of the program. In general, formal programs tend to be more appropriate for larger, highly structured organizations. Examples of programs with a formal mentoring component include NASA FIRST (an agency wide leadership development program), the Professional Internship Program (PIP) for entry-level NASA engineers, and the NASA Systems Engineering Leadership Development Program. When developing a formal program, human capital organizations must be careful not to craft programs that are excessively rigid or prescriptive. Even within a formal program, the mentor/mentee relationship should feel organic – in some instances, it may be best to establish the relationship through formal means, but allow it to proceed and develop in a more informal manner.

Informal mentoring describes relationships where mentoring is established and sustained by the mentor/mentee, without facilitation or support from the organization. These types of relationships are often formed serendipitously, and may cut across departments or even organizations. It is widely believed that this variety of mentoring is more effective, as relationships form more organically and are not predicated by an assignment or formal agreement. However, leaving mentoring to the devices of the mentors and mentees can alienate certain demographics, such as women and/or employees who may not feel comfortable approaching more senior persons for the purpose of mentoring. Women may encounter institutional barriers to mentoring due to a general lack of women in senior leadership, and in particular high ranking technical positions. Facebook CEO Sheryl Sandberg argues in her book "Lean In" that the success of cross-gender mentoring relationships hinges on creating an environment where male mentors and female mentees find it acceptable to have "alone conversations" in a professional context. Informal mentoring is advantageous from the company perspective since it does not require regular

meetings, reports, or a formal infrastructure to support it. However, the burden is on the company to provide opportunities for mentors and mentees to connect (for example, networking events and/or sponsoring young employees' attendance at technical meetings and conferences). The organization must also make an effort to incorporate those portions of the employee population who may be reluctant to seek out mentoring relationships in the absence of a formal program.

Regardless of whether they choose to adopt informal or formal approaches, companies are increasingly investing in software programs, based on professional networking platforms such as LinkedIn, to facilitate mentoring. 63% of survey respondents reported they had used such a site (internal to their organization) to establish and maintain mentoring relationships. These platforms may appeal to new employees who are uncomfortable approaching more senior members of their organization for guidance. An online network is a recommended supplemental approach for large companies/ organizations, where employees are spread across locations and time zones. Websites can also assist with mentor/ mentee matching.

4.1.4   Fostering a Culture of Mentoring

The most critical step a company can take to ensure knowledge transfer and employee development does not lie in the development of formal programs, but instead in fostering a culture where mentoring can occur and is supported. Encouragement of mentorship among more senior employees is crucial – they must understand their role in the process and the benefits of mentorship to the organization. Companies must also provide informal events (such as roundtables with senior leaders or "lunch and learn" talks) where young professionals have opportunities to meaningfully interact with leaders. Engagement in professional organizations and technical meetings goes along with a culture of mentorship, although participation and sponsorship of younger employees may be limited in the era of shrinking aerospace and defence budgets. We also suggest that organizations offer younger employees the opportunity to explore a variety of professional interests. While the famous "80/20"[*] initially implemented by Google may not be feasible in every organization (especially those which are focused on production rather than research and development), an effort should be made to allow young employees to take on stretch assignments or details/rotations where they can interact and develop relationships with mentors outside their specific discipline.

4.1.5   Conclusion

Mentorship is essential to bridge the generational gap and ensure that the "torch is passed" to a new generation of space professionals. The approach to mentoring will depend on the characteristics of the organization. It is the recommendation of this workshop group that the "hands off"/ informal approach is better suited for smaller organizations, but can work in large companies/agencies provided they have an established culture of mentorship. Cross-company/ agency/ organization mentorship is possible, but companies must provide opportunities for these relationships to grow. Within an organization, both the mentor and the mentee must understand the value of a mentorship program and be committed to it.

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[*] Google policy that encourages employees to spend 80% of their time on core projects, and roughly 20% on "innovation" activities that speak to their personal interests and passions.

Companies should provide training for mentors to clearly define their role and provide guidelines for interaction. Courses on how to mentor may also improve the interactions between senior leaders and young female professionals, who can sometimes be neglected. Not surprisingly, companies and organizations that value the individual and offer strong opportunities for professional development are highly sought after by young professionals. A culture of mentoring is a key component in building these attributes within an organization.

4.2 Topic 2 – Exchange Programmes

"What exchange programmes exist in different organisations (internal and external transfers) in the space sector?"

4.2.1 Methodology

Before the workshop, the group, distributed in eight countries, has been in contact through emails as well as regular Skype calls in order to share and consolidate the information gathered. The most important purpose of these meetings was to build up team spirit. The group did not use Facebook as a communication tool due to the access challenges for some participants.

4.2.2 Definition

The group has worked on two levels of definition. First of all, the exchange programmes have been defined with a narrow scope as *"an internal or external exchange of two persons' positions"*, i.e. this exchange can proceed between different organisations or inside the same organisation, without taking into account the location. Secondly, the group considered a broader meaning, defining exchange programmes as: *"exchanging or sharing persons' knowledge"* taking into account a variety of different initiatives. For example, Concurrent Design Facilities, remote workplaces, joint research projects, rotations and launch campaigns. Some educational programmes such as the Space Studies Programme from the International Space University or the SpaceMaster at TU Delft, were included in the definition's scope as well.

4.2.3 Current examples

The group reached the conclusion that not many exchange programmes exist, as defined previously, dedicated to young professionals in the space sector. Nevertheless, several other cases illustrate the opportunity and the benefits to set up such programmes.

In Asia, examples of Japan, China and India have been considered. The Japan Aerospace Exploration Agency (JAXA) showed interesting initiatives: external exchange programmes with a number of institutes and internal exchange programmes with ministries, universities, or private companies. JAXA sends every year employees to foreign institutes or academic institutions such as the European Space Agency (ESA), the National Aeronautics and Space Administration (NASA) or the International Space University (ISU). JAXA also welcomes foreign researchers as well as interns for a limited duration. On another example, there are only limited external exchange programmes between China and other countries in the aerospace field, but this is evolving rapidly. Cooperation with universities (e.g. between China Academy of Launch Vehicle Technology (CALT) and the University of Strathclyde in the United Kingdom) already exists. Some experts are also contributing to several International Academy for Astronautics' study groups. Regarding internal exchange, even if no formal framework can be found, many employees of CALT are sent case by case to ministries, universities or private companies. In the case of India, the cooperation between NASA and ISRO takes among others the form of exchange programmes for researchers.

From a European perspective, the secondment of space agencies' employees from the German Aerospace Centre (DLR) or ESA to international organisations such as Development Banks, United Nations offices, the European Commission or the European Space Policy Institute (ESPI) has been considered. Another example is the Dragon Programme between ESA and the National Remote Sensing Centre of China (NRSCC), where Chinese researchers went to ESA's European Space Research Institute (ESRIN). In the private sector, companies send employees as secondment in a case by case basis to ESA or other space agencies but no formal programmes exist as of today. Various exchange or mobility programmes, sometimes dedicated to young professionals, have been started in the private sector and then dropped for many reasons such as the difficulty to recruit the adapted applicant or the funding availability.

In the United States, NASA has some exchange programmes and one of the major international examples is the training of astronauts, who are sent to the different training places in US, Russia and Europe.

On a broader perspective, the case of exchange programmes for capacity building between space faring countries and emerging space nations can be considered as a good example as well.

4.2.4   Benefits and motives

Exchange programmes provide benefits at organisational level and from an individual point of view. Generally speaking, exchange programmes are undertaken by organisations to build up, sustain and share knowledge within the organisation. In addition, they develop the network of the individual and the organisation in and outside the entity. For the employee, these programmes enhance communication skills, cross-cultural knowledge and are often seen as rewarding for both personal and professional lives

As of today, most of the programmes take the form of continuous education programmes, mentorship initiatives or research partnerships. Some specific exchange programmes in the framework of technology transfer initiatives aim at developing capacity building.

4.2.5   Challenges

Barriers and drawbacks from an organisational and individual point of view might explain that exchange programmes as defined are not many. Organisations usually suffer from limited resources and funding, which impose restrictions to the implementation of such programmes. In addition, the exchange opportunities are sometimes not well communicated to potential participants.

The duration of an exchange is important, if too short it might not allow the participant to adapt and to have a meaningful experience. Selection of the participant is also an important factor; he or she must posses the needed motivation, skill (both professional and language), flexibility and cultural awareness for the new position. Careful planning must be given to the re-insertion of the participant after the exchange, either to the previous position or a new one that takes advantage of the newly acquired skills.

There are administrative challenges that need to be addressed as well before the programme starts. For example, cooperation agreements need to be in place; appropriate funding shall be secured; the organizations must support the participant with regards to relocation and immigration. When needed, appropriate Non-Disclosure Agreements (NDAs) must be set in place.

4.2.6 What could we change? - Recommendations

The group identified various and precise elements which could improve the existing exchange programmes as well as allow the development of new transfer opportunities, especially for young professionals.

Institutional framework: International cooperation agreements, with government support, are needed to further develop opportunities for partnerships between public institutions or private companies. It would be generally easier to start with cooperation and exchange programmes in fundamental research rather than large space projects. For this type of partnerships, international standards have to be developed. In addition, the cooperation between private and public sectors should be increased in order to allow a better understanding of both organisational cultures.

Organisational framework: Exchange programmes require an adequate framework from Human Resources to ensure a good preparation, a job guarantee as well as a planned progression of the person. The scope and objectives of the programme have to be adapted to the duration of the exchange. The organisation should also ensure the satisfaction of the team affected by the transfer, as a negative opinion could impact future exchanges. Control of the programme should be in the hands of the Human Resources department, rather than in the direct manager's hands.

Eligibility: These exchange frameworks should not be limited to young professionals but should be open to any person willing to learn and to provide knowledge to others.

Selection and *Integration*: A fair process of selection guarantees good participants to the programmes as well as a better communication on the results. It would be also necessary not to limit the scope of the exchange programmes only to scientific personnel or engineers but also to support functions. Moreover, integration should be carefully carried out through for example attentive mentoring at the beginning.

Skills: In some cases, it would be helpful to improve some skills of the employees, such as foreign language abilities prior to the exchange.

Interest: The initiative should come from a common interest, i.e. from the individual as well as from the hosting organization.

Knowledge: The initiatives should follow an interdisciplinary approach and the organisation should also set up a formal framework to keep track of the experience for future use. A knowledge management strategy from both sides (host and sending organisations) is key as well as a post-experience report and integration of the experience in the organisation knowledge base.

Communication: To avoid any lack of awareness regarding the opportunities of exchange programmes, communication tools should be put in place to inform the employees. Cost-benefits analysis and a bottom-up communication could be used to explain to the management the benefits of these programmes. For this purpose, the communication of the outcomes of the exchange to decisions makers and internal outreach are of major importance.

4.3 Topic 3 – On The Side Projects

"What optional "on the side" projects led by Young Professionals exist in different organisations in the space sector which tap into YPs' innovation, creativity and enthusiasm whilst maintaining their motivation and developing project management experience?"

4.3.1 Background

Upper management and human resources of all sizes of companies and organisations are always looking for new opportunities to tap into their workforces' nascent creativity and drive. One method to encourage this creativity is on the side (OTS) projects either in a person's free time or sponsored by their employer. One famous employer sponsored OTS project, is Google's 20 percent time, a most notable example. Some of Google's known and profitable products (e.g. AdSense, Gmail) have actually originated during this 20 percent of time. Some attractive aspects of OTS projects for the people working in them are hands on experience, a chance to do, create, make. This encapsulates many beneficial activities in one notion, the idea of doing, which is both motivating and an objective for many creative young professionals.

OTS projects come in many forms, each with their own benefits and utility. The group discussed those OTS projects supported through the work environment and not those personal or fully independent projects, which of course could also be supported through the provision of resources in much the same manner. A number of examples discussed during the workshop were used to identify a number of the traits that are present in successful programmes. A few of these successful programmes are found in the following list, which highlights the variety of activities that fall into the OTS category and their global nature.

- Google's 20 percent time
- Airbus Defence and Space's Graduate Development Programme, which requires young graduates to either, participate in the Campus Management or Astrium Re-Configurable Cube-SAT (ARC-SAT) projects.
- NASA's Innovative Partnerships Program (IPP) Seed Fund / ESA's General Studies Programme (GSP): Although not particularly aimed at Young Professionals, these programs could tap into YP's skills and motivation by making a specific earmark and advertising/encouraging their involvement.

4.3.2 Implementation

The group identified a number of models for OTS projects. These provide insight into the possibilities of for organisations in the implementation of their own type of projects:

- 120% (Overtime / Personal Unsupported Project): Good for short periods of time or for defining the initial phase of a project
- 80%/20% (Time availability): Good for software or feasibility work, presents limited possibilities of working with hardware without additional resources.
- Funded Resources but not time (e.g. business incubation centres, super-computer time availability, antenna/instrument time availability): Good for creativity with respect to a particular domain.

- Competitions: Foster creativity with respect to a goal; creates a competitive environment of incremental improvements.
- Full Funds: Provides the capital required to investigate new possibilities
- Time limited funds: Projects of opportunity, there are times when resources are available for short periods of time and need to be taken advantage of during these periods.

For organizations, OTS projects are generally attractive for making small investments in high-risk projects with the possibility of large returns. There are also a number of additional benefits, some of which are captured below:

- Hands on Learning: Regardless of project success or failure, the process will provide an opportunity for learning.
- Employee mobility: Training people to new career paths internally.
- Employee retention: Motivated employees have a higher retention rate.
- The ability to make mistakes and learn from them in a low cost environment
- Increase the external perception of the organisation as an innovator and a good working environment
- Adaptability of the workforce to dynamic conditions
- Innovation on standard products

The size of a company or organisation impacts how it implements OTS projects. Large organisations typically have resources available at one level or another and implement OTS projects in a formalised manner. Small and medium companies are generally more flexible and responsive, which gives room to more informal approaches. University OTS projects are typically based around research and innovation, making use of the availability of students free time and their desire for professional development activities.

Some elements should be present in order to implement a successful OTS programme. The first and foremost is support within the organisation's management, as it is a strong element of developing personnel and maintaining interest and mobility within the workforce.

A second element to successful OTS projects is resources, such as time and funding, even if in limited amounts. Financial resources allow projects to overcome significant barriers when attempting to achieve any form of development. Many University projects for example face the challenge of acquiring components, boards or basic tooling required to implement a project. Larger organisations, as an alternative, could provide hours of support from entities not included within the project, for example machinist, or managers to support the project in a professional manner.

If an organisation was to pursue OTS projects, what should it make available for the most impact?

- Management Support
- Recognition of the objectives, even if they are soft objectives
- Fair evaluation of the achievements
- Communication (advertise that these activities exist)

- Time, hours within the working day
- Funds
- Hardware (components, solar cells, etc.)
- Resources (laboratory, technicians, meeting rooms, etc.)

4.3.3   Resource Allocation

Once an organisation has identified what it plans to make available how would they award/allocate these resources? Google's 20% time was available to all employees, and this is entirely feasible when OTS projects just require time and a computer. However, when funds and other resources are made available, how should they be allocated? Based on a number of the successful OTS projects discussed before, proposals awarded at 1 in 3 applications seem to give an effective rate of return. A 1 in 3 proposal/award ratio ensures that there are a sufficient number of projects in relation to interest; it also ensures that poorly elaborated proposals are weeded out and that those activities that show the most promise have the opportunity to progress.

With regards to timing, there is no ideal schedule or funding duration, some projects had funding cycles as short as 6 months, and regularly rolled over to receive new 6 month funding blocks. On the longer duration there were OTS projects that received 4 years of funding with a gateway check at 2 years. In the shorter duration funding scheme, those projects that did not realise as planned naturally withdrew from funding as the proposal for funding acted as a gateway review and tracking of progress.

4.3.4   Lessons Learned

Some lessons learned are listed below, taken from OTS projects which have either not gotten off the ground or were not deemed successful:

- Lack of a convinced and supportive management
- Lack of funds or access to required hardware
- Lack of access to required skill sets
- Significant delays due to bureaucracy, e.g. it takes so long to get a budget such that people are no longer available or interested in an OTS project
- Lack of proper mentorship or access to expertise
- Perceived negative career impact as a result of failure
    - Hard definitions on participation, e.g. age cut off, no longer eligible for funding, etc.

4.3.5   Challenges

In addressing why OTS projects are not initiated within various organisations two clearly identifiable criticisms were identified and addressed.

"Scarce Resources makes it difficult to support OTS projects."

- Very limited resources can make a huge impact on OTS projects by giving the project legitimacy and help overcoming hurdles insurmountable outside the working environment. It is important to

provide the time to pursue OTS projects, which represents a limited cost in these days of 40+ hour workweeks.

- OTS Projects can address very risky projects with a limited investment. Activities with a high risk of failure, if balanced with a large return on investment, represent an opportunity for the organisation.
- Avoid squandering scarce resources through a competition to allocate resources. This provides a proper vetting for activities before their selection.
- Time limitations provide a limited risk exposure and limited amounts of money, as well as milestones for demonstrable achievements.
- OTS projects act as employee motivation. Employees with a pet project will work harder on the daily activities to make time for their side projects. This maintains productivity while adding the value of the side project.
- One valid point is that an organisation should play to its strengths and not deviate too far from its core business only because a project is appealing to an employee or group.

"OTS projects lack demonstrable benefits and are just a distraction to daily work"

- On the job training and hands-on experience are valuable for any workforce. These experiences can build the reputation of the organisation and be used for recruitment and retention.
- OTS projects will motivate employees, encouraging the most efficient use of time.
- People have time already for social interactions and personal email, make use of their interests in OTS projects to recapture slack time and social conversation.
- The outputs of some OTS projects can result in new business lines as well as opening up access to new markets

4.3.6   Conclusion

On the side projects should be supported by organisations as they can provide many benefits such as improving employee motivation and retention. A number of different models have been identified for OTS which should be tailored to the size and working culture of the organisation. Also through an OTS it is possible to make small investments in high-risk projects with the possibility of large returns. It is essential that OTS get support from management, as well as some supporting resources (time and funding). It is recommended that on the side projects be encouraged in organisations as they can present new opportunities to tap into their workforces' creativity, allows for hands on learning and enable innovation.

4.4 Topic 4 – Project Organization Tools and Methodologies

"What tools and project organization methodologies have been and can be implemented into the space sector from other industries and the YPs' experience (e.g. software, automotive)?"

4.4.1 Introduction

Space is a challenging business. In recent years companies, as well as other organizations involved, have been under increased pressure to quickly adapt to the current economic situation of financial uncertainty. Investors are setting lower values on high-risk, long-term projects. This is creating a situation of capital scarcity in the space industry that, together with smaller backlogs, is hindering the future competitiveness of the industry. Competition and smaller project budgets put organizations involved under pressure, and force them to seek internal efficiency increases while maintaining the product quality.

Similarly to the above described, other global industries are being challenged to increase their internal efficiency. This leads to the question: "What tools and project organization methodologies have been and can be implemented into the space sector from other industries and the YPs' experience?" The IPMC Workshop group 4 addressed these issues, identified four areas, and formulated four recommendations for space industry to focus on and benefit from.

The work done by the group can be split into three phases. Before the workshop started, eight possible focus areas were identified and discussed by the group members. Since the group has truly global coverage (six members from three different continents), meeting was possible thanks to online communication and social media. During the workshop the group focused on only the four most important areas that would be further discussed after delegates returned back to their home organizations. Based on all of this valuable work, the below opportunities for tool and methodology transfer were complied.

4.4.2 Opportunities for Tools and Methodology Transfer

The most important findings of the working group are the significant opportunities for tools and methodology transfer within the space industry itself. Significant differences in how thing are done were identified and outlined below together with areas where space industry can learn from other industries.

Software development tools

Currently, software development requirements are based on large and complex programs such as ISS, Space Shuttle and others. For these large-scale missions, NASA, ESA and other important bodies tend to require formal, long documents to capture mission requirements. These large-scale mission approaches are burdensome to smaller missions. For missions such as cubesats, phonesats, and other low budget projects, there are not yet clear standards for how to adapt the documentation requirements in order to make them more manageable but still effective.

There is an effort by NASA to work with software companies and use workshops to propose new methods for project management documentation. For now the focus is on unmanned space missions.

The inspiration is coming from companies like Cisco where they build large software packages, but they use smaller sections and do testing in modules. The use of lean and agile-inspired methods is a norm within software industry and space industry can significantly benefit from these methods when applied in appropriate projects.

Group Recommendation: Evaluate use of Lean, Agile, and Scrum software development practices successfully used by other industries.

Process Improvement Techniques

The Iridium programme is an example of successful process improvement based methodology. Even though unsuccessful on the business side Iridium was very successful from the engineering and production point of view. Iridium was able to produce 66 satellites quickly and reduce the manufacturing costs. This was achieved by implementation of production line techniques from the automotive industry.

Space industry can focus on process improvement inspired by other industries in areas like standardization on component as well as on bus level, standardization of launcher loads and interfaces, waste reduction, visualization and virtual reality application in design process and may others. Therefore it is seen beneficial to organize cross industry workshop on all levels to allow for tools and methodologies transfer.

Group Recommendation: Support cross industry workshop on all levels to allow for methodology transfer.

Project Management and Systems Engineering Certification

In many industries significant opportunities are available to project managers and systems engineers to continue with their professional education and development. Within the space sector and especially in agencies and academia the available self-development opportunities are not focused on project management and systems engineering. This, together with employment approach where project managers and systems engineers are placed in position mainly based on seniority and not based on experience within relevant filed, can lead to significant cost and schedule issues.

To eliminate these issues, affected space organizations should get inspired by other industries (including private space organizations). The specialist with appropriate experiences should be employed where possible and adequate education and training should be provided to all cross function employees. Even though this comes with significant cost burden in short term the long term benefits are worthwhile.

Group Recommendation: Support cross-educational training for current staff and/or hire additional cross-educated staff.

Company Organizational Structure

Various organizational structures are employed in space industry not only by companies but also by governmental agencies. Based on the workshop delegates' personal experiences the organizational

structures within CAST, ESA, NASA, JAXA and others were discussed. Even though there are significant differences in how these institutions work, areas where space industry can learn within itself were identified. Examples of such a situation are presented below.

It is common around the globe that people are assigned to multiple projects, contrary to JAXA where the number of projects is limited (often only to one). Even though work on multiple projects is necessary and has its own advantages delegates agreed that the number of projects one person is working on have to be limited to as few as possible. The knowledge transfer and development in such an environment can be ensured by project rotations and review process.

Group Recommendation: Limit the number of projects the person is assigned to in the matrix organization.

4.4.3 Conclusion

Space is a challenging business where quality and reliability have been until now main drivers. Due to a changing landscape where governmental budgets are falling under significant pressure and are becoming less and less important in overall space industry expenditures on global level. These changes are increasing pressure on space industry to become more competitive while not scrutinizing the quality of delivered products. The working group identified four areas where the space industry organizations can learn from each other and from outside as presented above.

Delegates have also discussed how to implement these changes within their home organizations. An example activity is lean and agile software development being investigated by NASA for small satellites projects. Additionally, thanks to global coverage of the group, significant differences between project management tools and methodologies were identified. This finding stressed even more the need for global cooperation within the space industry especially on governmental level. It was also agreed that systems engineering should be treated together with project management due to significant overlap between the two fields and this was reflected throughout the working sessions held by the group.

Project management and systems engineering tools and methodologies transferred from outside as well as within the space industry play an important role in fulfilling stakeholder expectations. Well proven methodologies and tools, together with lessons learned, have potential to significantly reduce project cost while maintaining required quality of the final product. Industry leaders should not overlook tools and methodologies transfer, as the topic is becoming more important with increasing competition within the space sector and is going to have a significant impact on industry development.

4.5   Topic 5 – Knowledge Exchanges and Networking

What methods exist for promoting knowledge exchange and networking between YPs at different organisations in the space sector?"

The group tackled this topic via two streams. The first one, carried out by the team during the four weeks prior to the workshop, was focused on the analysis of the current activities in the Space sector to promote knowledge exchange and networking between YPs. The second one, performed during the workshop held in Beijing, was focused on the implementation and improvement opportunities. Finally, a set of recommendations based on the results of workshop discussion is proposed. The key facts of these activities are summarized below.

4.5.1   Activities carried out by main organisations in the Space sector

With the purpose of analysing current activities that contribute to promote knowledge exchange and networking between YPs, the following sources of information were used:

Internet research

As defined by the "OECD Handbook on Measuring the Space Economy" the principal actors in the Space sector can be classified into business enterprises (e.g. companies), public actors (e.g. space agencies, technology centres, etc.) and higher education actors (e.g. universities, research institutes, etc.). The straightest approach to address the topic would be to research the programmes in place in major actors in terms of workforce. However, as mentioned in the OECD report "The Space Economy at a Glance 2011", the lack of harmonised statistical data on employment in the global Space sector makes difficult to take this approach (e.g. different counting methods, insufficient detail and quality of the data sources). Instead of workforce volume, the study focused on major businesses in the space sector in terms of revenue, and on the biggest civil space agencies in terms of budgets.

Company	Revenue US$ millions
Boeing	81698
EADS	72587
Lockheed Martin	47182
General Dynamics	31513
United Technologies	29089
BAE System	28263
Northrop Grumman	25218
Raytheon	24414
Finmeccanica	22128
GE Aviation	19994
Rolls Royce	19273
Thales	18196
Safran	17427
L3 Communications	13146
Honeywell Aerospace	12040
TOTAL	**462168**

Top 15 business enterprises working in the space sector in terms of revenues 2012 as per PwC "Aerospace & defense 2012 year in review", representing more than two thirds of the revenues of all the companies addresses in the mentioned report

Country	Budget US$ millions	Space agency
United states	43600	NASA
China	6502	CNSA
European Union	6294	ESA
Japan	3551	JAXA
Russia	2665	Roscosmos
India	1193	ISRO
Canada	338	CSA
TOTAL	**64143**	

Space agencies of the top 7 countries in terms of space budgets in 2010 as per OECD "Handbook on Measuring the Space Economy", representing 99% of the space budget of the G20 countries.

4.5.2   Young Professionals Survey

To complete the information gathered about the main actors of the Space sector, the team launched a survey targeted to YPs. The email lists of the main space organisations related with YPs at global level were used for that purpose (IAF, ISU & SGAC).

 The questions included in the survey were oriented to the following subjects:

- Categorization of the participants
- Current activities for promoting knowledge exchange and networking
- Needs and expectations expressed by YPs
- Benefits of the activities currently in place

As result of the search performed through the sources mentioned, the following information on the main activities to promote knowledge exchange and networking for YPs in the Space sector was found. A complementary search on other sector´s key companies was carried out for benchmarking purposes.

Business enterprises	International assignment	Rotational assignment	Management & Development	Tuition assistance	Conferences, meetings, workshops	Mentoring / Coaching	Peer to peer exchange	Networking	Key programmes
Boeing	X	X	X	X	X	X		X	BCFP & REACH
EADS	X	X	X	X	X	X		X	PROGRESS
Lockheed Martin	X	X	X	X	X	X		X	LDP
General Dynamics	X	X	X			X		X	GDP
United Technologies	X	X	X					X	LP
BAE System	X	X	X	X	X			X	GDP
Northrop Grumman	X	X	X			X	X	X	FTLP & Connect1NG
Raytheon	X	X	X			X		X	LDP & YESNET
Finmeccanica	X		X		X			X	BEST
General Electric	X	X	X			X	X	X	LP
Rolls Royce	X	X	X	X		X		X	GDP
Thales	X	X	X					X	Thales Together
Safran	X	X	X					X	Corporate University
L3 Communications	X	X							N/A
Honeywell	X	X	X			X		X	ECDP

Space agencies									
NASA		X	X		X	X		X	APPEL & FIRST
CNSA		X				X			Talent Rely
ESA	X	X	X	X	X	X		X	YGT,RFP & University
JAXA		X			X			X	ITYF
Roscosmos			X						N/A
ISRO			X						N/A
CSA		X	X						YG

Benchmark with other sectors |	International assignment	Rotational assignment	Management & Development	Tuition assistance	Conferences, meetings, workshops	Mentoring / Coaching	Peer to peer exchange	Networking	Key programmes
United Nations	X	X	X		X	X		X	UN YPP Networks
Microsoft	X	X	X		X	X		X	Employee groups
BMW	X	X	X			X		X	GP & Mgt. Associate
Boston Consulting Group	X	X	X		X	X		X	LAB & secondments

The survey results shown below were obtained up to September 2013, from a total of 46 participants around the world.
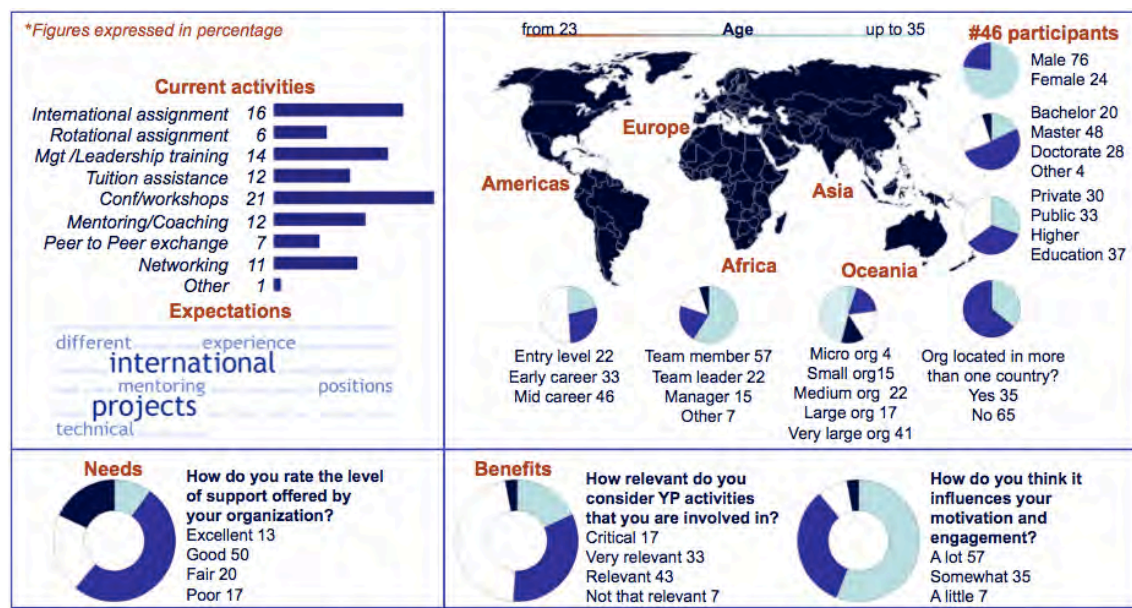
The main conclusions were the following:

• Common trend around the organisations of the sector on mixing training and hands on experience to ensure the transfer of knowledge to YPs.

• Many organisations have established development programmes, which include international experience, rotational assignments, training opportunities, mentoring and networking to accelerate the YPs development.

• Focus on structured networking activities as tool to enable exchange and sharing experiences.

• Benchmark with other sectors highlights a similar trend in other organizations and also proposes interesting ideas like temporary assignments in external stakeholders.

• Knowledge transfer and networking activities have a positive impact in the motivation and engagement of YPs

4.5.3   Implementation and improvement opportunities

Based on the analysis shown and the experience as YPs of group members, the workshop discussion focused on implementation and improvement opportunities for promoting knowledge exchange and networking. The approach selected to address this subject was to identify and to classify the additional methods that exist and to analyse their benefit as well as estimate the investment required.

Types	Examples	Networking	Education Hard Skills	Education Soft Skills	Team collaboration & Research	International Exposure	Ideas Exchange	Investment In US$
Professional Organizations	AIAA membership	High	Low	Medium	Medium	Medium	Medium	Thousands
	SGAC	High	Low	Medium	Medium	High	Medium	Thousands
	IAF	High	Low	Medium	Medium	High	Medium	Thousands
Academic Programs	Masters	High	High	Medium	High	Medium	High	Tens of thousands
	Graduate	High	High	Medium	High	Medium	High	Tens of thousands
	Training & Certificates	Medium	High	Medium	High	Medium	High	Thousands
Alumni Networks	University	High	Low	Medium	Low	Medium	Medium	Thousands
	ISU	High	Low	Medium	Low	High	Medium	Thousands
	Others	High	Low	Medium	Low	Medium	Low	Thousands
Geographic Clusters	Cluster membership	High	Low	High	Low	Medium	High	Tens of thousands
Online Collaboration Tools	Wiki	Medium	Low	Low	Low	High	Medium	Hundreds
Conferences/Meetings	IAC	High	Low	Medium	Medium	High	High	Thousands
Competitions	Google Lunar XPrize	Medium	Medium	Medium	Medium	Medium	High	Thousands
Institutional Partnerships	Exchange Programs	High	Medium	High	High	Medium	High	Tens of thousands
	Internships	High	High	High	Medium	Medium	High	Tens of thousands

4.5.4   Recommendations

The main recommendations obtained based on the results of the workshop are the following:

- The benefits of each of these opportunities for YP networking should be reflected in organizational management and in professional development
- Organizations should create a culture that values knowledge transfer as input into operations, and engage these opportunities. To do so, they should:
  o Attempt to quantify the benefits of participation in these activities, and reflect that value in budgets for participation by their employees
  o Be clear on the relative level of corporate support / individual volunteer time for investment in these opportunities
  o Consider the benefits of location, and view marginal costs of salary and office space an investment in peer to peer networking opportunities
  o Continue support for tuition for training and education
- Individuals should take responsibility for their value as a node of transfer, and:
  o Consider participation in these activities as investment in professional development
  o Gauge the level of volunteer time they want to invest for their desired outcome
  o View geographic location as a professional decision and investment

5   Conclusions

After a few intensive weeks of online sessions, the second IPMC YP workshop 2013 took place on September 20th in Beijing, China. Forty delegates attended the workshop with very different backgrounds and from all around the world, including eighteen countries from four continents: Europe, Asia, America and Africa.

The delegates were divided in five different groups (each dedicated to one topic) and they were asked to overcome the first challenge by finding a common way to communicate when not in the same office, the same city or even country and in some cases the groups spanned over several continents! It was very impressive to see what young motivated people can accomplish!

This report is a result of this accomplishment. This report also shows us that there is continuity, as we have found similar conclusions from both the 2012 and 2013 workshops.

In both workshops mentoring programmes were an important topic. YPs felt it was important to have clear and effective mentorship programmes. The distinction was made between formal and informal programmes -- both showing many benefits that can be implemented depending on the professional culture or size of the organisation. Though the details on what kind of monitoring programme is needed and who precisely should implement this programme remained unclear, it is in any event clear that mentorship programmes are essential.

Another topic that has been discussed this year and last year was about exchange programmes. Many similarities are shown from the discussions and the outcome. The key to a successful exchange programme is not only funding and resourses but also the selection of the participants. The groups research and discussion also pointed out how crucial re-insertion of the participant after the exchange is. The organisation should benefit from this experience and make use of the new gained knowledge and experience.

Throughout the workshop, and as shown in this report, management support and funding are big motivators and key resources in the successful implementation of workforce development programmes. Whether it is the exchange programmes or the "on the side projects" where people invest their own time in activities that are not their day-to-day work, the hands on learning effect and the opportunity to work in a team in additional to normal work is extremely motivating and has a positive effect on the retention of YPs throughout the space industry.

Related to this is the possibility to exchange knowledge and the opportunity for networking. For this workshop a survey was conducted to further understand the expectations and benefits of these mentioned topics.

The outcome shows that many organisations have established workforce development programmes, which include international experience, rotational assignments, training opportunities, mentoring and networking to accelerate the YP's development. The group worked on various implementation tools

during the workshop. What stands out is the support and recognition that YPs are seeking from their management/organisation, and that this is not just important for the YPs to maintain their enthusiasm for space but also for the organisation, that can greatly benefit from the additional knowledge and the newly gained experience.

6   Following steps

After another successful IPMC YP workshop we see a trend in the various discussions throughout the groups. We see the enthusiastic attitude from the YPs, we see their interest in how other YPs deal with similar challenges and topics and ideas. It is also clear that good ideas are found during the workshop because everybody is highly motivated.

We want to use this motivation and make the outcome of this workshop even more tangible. How can we help develop and empower the next generation workforce?

There have been lessons learned from the first two workshops and we will take them and use them for the 2014 workshop. All recommendations from previous years will be taken into consideration and implemented where possible and applicable.

A few changes for next year's IPMC YP workshop have already been decided:

- The first draft of the 2014 IPMC YP workshop report will be ready by the end of the IAC.
- There will be six topics compared to five in previous years to have smaller groups and have a more detailed input.
- The 2013 survey will be continued.
- Pre-workshop sessions will start end July / early August

7   List of Workshop Delegates

Organisation	Participants
Astrium Ltd.	Nick Fishwick
Manipal Institute of Technology, Manipal University	Balbir Singh
United Launch Alliance	Tracie Prater
German Space Operation Center	Guillaume Girard
Deutsches Zentrum für Luft- und Raumfahrt (DLR)	Kevin Shortt
	Ahmed Farid
European Space Agency (ESA)	Julio Aprea
	Birgit Hartman
	Chris Runciman
	Sven Richter
	Guiseppe Ottavianelli
	Anna Pacros
Snecma	Guillaume Chelma
Space Commercial Services Holdings (Pty), Ltd	Khalid Manjo
Astrium GmbH	Noemie Bernede
Emerging Space Leader (IAF)AF)	Kishor Acharya
Japan Aerospace Exploration Agency (JAXA)	Atsushi Ueta
	Tetshuhito Fuse
The Aerospace Corporation	Danielle Wood
Korea Aerospace Research Institute (KARI)	Dong-Hyun Cho
Institut d'Estudis Espacials de Catalunya	Zubin Olikara
China Academy of Space Technology (CAST)	Haitao Liu
	Rui Li
San Jose State University	Jessica Culler
Academy of Launch Vehicle Technology	Wang Xiawei
Space Generation Advisory Council	Alex Karl
Seoul National University	Ji Hyun Park
National Space Science Center	Ya-Nan Tong
The Planetary Society	Kevin Stube
Pakistan Space & Upper Atmosphere Research Commission	Sohaib Akbar
Shaanxi Engineering Laboratory for Microsatellites	Xiazhou Yu
Technical University Denmark	Jan Svoboda
Istanbul Technical University	Ozan Kara
Yuzhnoye State Design Office	Andrii Kukhta
Airbus	Amalio Monzon
Main Astronautical Observatory of Ukraine	Sergii Kuzkov
Northwestern Polytechnical University	Huang He
Secure World Foundation	Tiffany Chow
University of Lapland, Finland	Zhuoyan Lu
Tauri Group	Paul Guthrie
National University of Science and Technology (NUST)	Constant Chuma
China Aerospace Science and Technology Corp.	He Wei