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Informe sobre el Taller Universidad del Futuro Colombia-Purdue

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UNIVERSIDAD DEL FUTURO
INFORME BASADO EN UN TALLER COLOMBIA-PURDUE

EL INFORME

PURDUE
UNIVERSITY

28-29 de octubre de 2014
Universidad de Purdue
West Lafayette, Indiana USA

Universidad del Futuro Informe basado en un Taller realizado en la Universidad de Purdue 28-29 de octubre de 2014

Taller Colombia-Purdue

Panorama

El Taller Universidad del Futuro se llevó a cabo en la Universidad de Purdue en West Lafayette, Indiana, el 28 y 29 de octubre de 2014. Coordinado por el presidente de Purdue Mitch Daniels, los participantes incluían rectores y consejeros de seis de las principales universidades de Colombia, junto con directores ejecutivos de ONG, funcionarios públicos de ambos países, y profesores y administradores de Purdue.

El taller fue un paso importante hacia la ampliación del diálogo (un conversatorio) entre todos los participantes del taller para definir qué características son esenciales para que las universidades den respuesta a las necesidades del siglo XXI en toda América.

Resumen Ejecutivo

Declaración marco y panorama avanzado del taller

Antes del Taller Universidad del Futuro, se distribuyó a todos los participantes una declaración marco, citada a la izquierda, y un panorama del alcance del taller, incluidos en el Apéndice I. El espíritu del taller era avanzar en alianzas ya desarrolladas con Colombia y trabajar juntos para progresar en el cambio transformacional en el sistema universitario.

Temas clave y recomendaciones

Los temas clave del taller incluyeron: a) Educación Transformadora, b) Redes de Excelencia para la Investigación, la Educación y la Innovación en colaboración, y c) Ecosistemas de Innovación. En cada sesión temática, se ofrecieron presentaciones de encuadre para estimular el diálogo sobre asuntos relacionados con los tres temas. Después de las presentaciones, los participantes del taller iniciaron discusiones abiertas. El programa del taller se incluye en el Apéndice II. Las recomendaciones propuestas en este informe se basan en las discusiones focalizadas en los tres temas clave del taller.

Aporte de los participantes

Cuestionario previo

Antes del taller, los participantes completaron un cuestionario. En el taller se presentó un resumen de las respuestas que se incluye en el Apéndice III.

Discusiones focalizadas en el taller

Los participantes discutieron las metas, los desafíos y las oportunidades clave para la educación superior, tanto en Colombia como en los Estados Unidos, y exploraron enfoques para colaboraciones multiinstitucionales, multisectoriales y multinacionales.

Entrevistas estructuradas post-taller

Después del taller de octubre, Liliana Gómez Díaz, directora de Alianzas y Compromiso con Colombia en Purdue, llevó a cabo entrevistas estructuradas con los participantes. En el Apéndice IV aparece un resumen.

Comparación de las universidades norteamericanas y colombianas

En el Apéndice V se presenta una comparación de los sistemas universitarios de Estados Unidos y Colombia. Las similitudes y diferencias entre prestigiosas universidades de ambos países aportan un importante contexto para evaluar potenciales colaboraciones así como esfuerzos para transferir programas y mejores prácticas a través de las fronteras nacionales.

Propuesta de Taller de Seguimiento

Se planea para el 2015 un taller de seguimiento en Colombia, con representantes de empresas, gobierno y universidades entre los asistentes.

Participantes

El taller incluyó la participación de rectores y consejeros de seis importantes universidades de Colombia, junto con directores ejecutivos de ONG, funcionarios públicos de Estados Unidos y Colombia, y profesores y administradores de Purdue (liderados por el presidente de Purdue Mitch Daniels, fotografiado a la izquierda). La Universidad de Purdue fue anfitriona del taller y participó en las discusiones.

Participantes Externos	Institución
Jorge Ivan Bula	Vicerrector, Universidad Nacional de Colombia
Pablo Navas	Rector, Universidad de los Andes
Alberto Uribe	Rector, Universidad de Antioquia
Juan Luis Mejía	Rector, Universidad EAFIT
Edgar Parra	Rector, Universidad de Cartagena
Julio Jairo Ceballos Sepúlveda	Rector, Universidad Pontificia Bolivariana
Juan Rafael Cardenas	Consejo Directivo, EAFIT
Juan Guillermo Ochoa	Consejo Directivo, Universidad Pontificia Bolivariana
Luis Carlos Villegas	Embajador colombiano ante Estados Unidos
Anne Slaughter Andrew	Exembajadora de Estados Unidos ante Costa Rica
Susan Bell	Embajada de Estados Unidos en Colombia
Ann Mason	Directora ejecutiva, Fulbright Colombia
Jerónimo Castro	Director ejecutivo, Colfuturo
Juan Camilo Quintero	Director ejecutivo, Ruta N, Medellín
Juan Ernesto de Bedout	Comité Asesor Externo, Facultad de Ingeniería
Steven Dorsey	International Institute of Education
John McDonald	Gerencia de General Electric Energy

Presentadores del Encuadre	Institución
Mitch Daniels	Presidente, Universidad de Purdue
Suresh Garimella	Vicepresidente ejecutivo para Investigación y Alianzas, Purdue
John McDonald	Gerencia de General Electric Energy
Anne Slaughter Andrew	Exembajadora de Estados Unidos ante Costa Rica
Luis Carlos Villegas	Embajador colombiano ante Estados Unidos
Frank Dooley	Vicerrector para Asuntos Académicos de Grado, Universidad de Purdue
Ananth Iyer	Director de Purdue NExT
Dan Hasler	Presidente y director empresarial, Purdue Research Foundation
Nathalie Duval-Couetil	Burton D. Morgan Center para Emprendimientos, Purdue
Cliff Wojtalewicz	Burton D. Morgan Center para el Emprendimientos, Purdue
Juan Camilo Quintero	Director, Ruta-N
Gerhard Klimeck	Red para Nanotecnología informática, Purdue
Michael Ladisch	Laboratorio para Ingeniería de Recursos Renovables, Purdue

Comité Directivo

Suresh Garimella, vicepresidente ejecutivo para Investigación y Alianzas, y distinguido profesor Goodson de Ingeniería Mecánica, Universidad de Purdue, sureshg@purdue.edu

Anne Slaughter Andrew, exembajadora de Estados Unidos ante Costa Rica.

Liliana Gómez Díaz, directora de Alianzas y Compromiso con Colombia en Purdue, lgomezdi@purdue.edu

Arvind Raman, jefe docente del Colombia-Purdue Institute y decano asociado de Ingeniería para Programas Globales, Universidad de Purdue, raman@purdue.edu

David Janes, profesor de Ingeniería Electrónica e Informática y coordinador docente de Alianzas Institucionales, Universidad de Purdue, janes@purdue.edu

Suzanne Nielsen, profesora de Ciencia de los Alimentos y miembro de Asuntos Globales para Iniciativas Especiales, nielsens@purdue.edu

Temas Clave y Recomendaciones

Los participantes identificaron durante la discusión varias cuestiones clave asociadas con los temas del taller. Estas aparecen en esta sección del informe, seguidas por las recomendaciones propuestas. Las recomendaciones sintetizan los resultados temáticos en programas de capacitación estructurados o recursos destinados a lograr que los temas del taller se conviertan en un cambio transformacional. Cuestiones como "enseñanza y aprendizaje" y "desarrollo de los docentes" representan necesidades y metas que atraviesan las áreas temáticas y sirven de base para una serie de recomendaciones. Se sugieren "Redes de Excelencia" para generar colaboraciones entre las principales partes interesadas, a fin de desarrollar la economía basada en el conocimiento que es necesaria para la innovación. Se anticipa que otras partes interesadas del gobierno, ONG y empresas contribuirán al diálogo en futuros talleres.

En el futuro cercano podrían darse los pasos iniciales hacia la implementación de las recomendaciones en una determinada categoría. Sin embargo, una puesta en marcha total de programas abarcadores puede requerir diversas etapas que involucren demostraciones iniciales con evaluaciones y ajustes para alcanzar una amplia adopción.

Tema: Educación Transformadora

Cuestiones identificadas en el taller sobre:
Enseñanza y aprendizaje

- Proceso de enseñanza y aprendizaje
- Tecnologías de la Información y la Comunicación (TIC), que incluyen
  - Aula no tradicional en línea
  - Pedagogía en línea
  - Presencia virtual de profesores externos en línea
  - Sistema en línea basado en las competencias
- Desarrollo del currículo y contenidos compartidos
  - Abordar las áreas técnicas emergentes y las áreas de enfoque relevantes para Colombia
  - Compartir contenidos de cursos avanzados entre instituciones y regiones
- Rol de la universidad en el desarrollo sustentable de la nación
  - Las universidades colombianas podrían considerar una versión del modelo de "land-grant[1] university" de Estados Unidos.
  - Además de los establecimientos urbanos, las universidades deberían servir a áreas menos pobladas
  - El desarrollo de la fuerza laboral puede incluirse en el enfoque universitario

Recomendaciones: Enseñanza y aprendizaje

Aprendizaje centrado en el alumno

El aprendizaje centrado en el alumno puede incluir clases no tradicionales, por ejemplo, módulos de cursos en línea y enfoques de clase "invertidos", en los que el material se presenta en línea y el tiempo de clase se dedica a actividades interactivas con grupos de estudiantes. La implementación exitosa de estos abordajes requiere comprender conceptos, así como desarrollar metodologías específicas, optimizadas para el ámbito local. Las recomendaciones específicas incluyen:

a. **Desarrollar talleres de enseñanza para ilustrar los conceptos de enfoque de clase no tradicional y módulos educativos en línea.** Estos talleres representan un primer paso para ilustrar los conceptos e identificar los participantes potenciales en una implementación más extensa.

b. **Desarrollar en Colombia un grupo de expertos en enfoques no tradicionales de enseñanza y en módulos educativos en línea, y brindar infraestructura y recursos para capacitar y asesorar a otros.** Un grupo así podría constituir el núcleo central para implementar nuevos enfoques de enseñanza, así como desarrollar expertos para capacitar a la próxima generación de docentes en las técnicas asociadas. Colectivamente, este grupo debería brindar asesoramiento en diversas disciplinas, junto con actividades académicas para diseño y evaluación del curso. Esta fase debería incluir recursos y tiempo libre para que los participantes hagan visitas prolongadas (semanas a meses) a una universidad con un programa establecido en enfoques de clase no tradicionales.

c. **Definir la infraestructura y el sistema de recompensas para la adopción amplia de enfoques no tradicionales de enseñanza en la clase y módulos educativos en línea.** La infraestructura incluye espacios de clase adecuados para ejercicios interactivos con estudiantes. Los incentivos docentes pueden incluir tiempo disponible para el desarrollo de cursos, compensación financiera, o ascensos y reconocimiento.

Tecnologías de la información y la comunicación (TIC)

Las tecnologías de la información y la comunicación (TIC) refieren a un amplio conjunto de recursos, entre ellos, programación informática, visualización, interfaces humanas e informáticas, y uso de herramientas informáticas en el aula. Las TIC representan una importante habilidad para los estudiantes y un conjunto relevante de herramientas y recursos para los docentes.

a. **Desarrollar programas de capacitación en TIC para instructores y profesores de la universidad**. Los programas de capacitación para instructores brindarán un beneficio directo en términos de implementación en la clase. Los instructores bien capacitados podrán

brindar a los estudiantes una mejor capacitación en el uso de las tecnologías informáticas.

b. **Definir la infraestructura y los incentivos para una amplia adopción de TIC en las clases universitarias.** La amplia implementación de TIC en el aula (y más allá) puede tener un impacto significativo en las metodologías educativas así como en la experiencia de los estudiantes. En particular, en las primeras etapas, se requerirán recursos tanto para el desarrollo como para la implementación en clase. Deben ponerse en marcha estructuras apropiadas para incentivar a los miembros del cuerpo docente a liderar estos desarrollos.

Cuestiones identificadas en el taller sobre:
Desarrollo integral del alumno (más allá del conocimiento meramente técnico)

- Valores y ética
- Bilingüismo (en particular, inglés)
- Aprendizaje más allá de la clase (proyectos, aprendizaje experiencial, proyectos socialmente relevantes)
- Programas internacionales
    - Aumento de movilidad a Colombia
        - Alumnos de grado, estudiantes de doctorado

Recomendaciones: Desarrollo integral del alumno

Un tema común tanto en las respuestas del cuestionario como en los comentarios en el taller se refirió a la necesidad de desarrollar "al alumno en su totalidad". En líneas generales, los comentarios se referían a brindar al estudiante experiencias que fueran más allá de los típicos cursos temáticos, por ejemplo, para educar a los alumnos en cuestiones sociales y éticas, y aumentar sus experiencias internacionales. Las recomendaciones específicas para el futuro cercano abarcan el aprendizaje experiencial, programas de inglés, y programas para aumentar la movilidad a Colombia. Incrementar el intercambio estudiantil internacional a Colombia tendría un impacto positivo para alcanzar esta meta. El foco debería estar en formar líderes ciudadanos del mañana, y poner a disposición de todos los sectores de la sociedad oportunidades de manera inclusiva.

Aprendizaje experiencial

a. **Desarrollar programas de aprendizaje experiencial que incluyan componentes relacionados con cuestiones sociales y aprendizaje por medio del servicio comunitario.** Los programas de aprendizaje experiencial son un fuerte complemento a los enfoques de clase tradicionales, pues incluyen oportunidades de abordar problemas de final abierto, concentrarse en asuntos sociales, y conectar con la comunidad que está más allá del campus universitario. Colectivamente, estas actividades brindan una educación más completa a los estudiantes, y los preparan para un papel proactivo en la sociedad y una carrera productiva.

Desarrollo de programas de inglés para estudiantes

a. **Desarrollar programas de inglés como segunda lengua que puedan compartirse entre muchas instituciones.** El dominio del idioma inglés es considerado importante tanto porque permite a los estudiantes experiencias internacionales más amplias, como porque los prepara para carreras en ámbitos multinacionales. Si bien existen programas de inglés como segunda lengua en una serie de instituciones, sigue siendo una necesidad desarrollar programas más accesibles para los estudiantes, en particular, los que están fuera del campus.

b. **Crear alianzas con universidades en países de habla inglesa para fomentar la movilidad de los estudiantes a esos países y permitir que desarrollen sus habilidades en inglés.** Los programas internacionales brindan un importante incentivo para que los estudiantes se centren en el desarrollo de habilidades en lenguas extranjeras. Las alianzas de largo plazo podrían brindar experiencias de inmersión a los estudiantes y oportunidades de establecer relaciones duraderas con pares de otras instituciones.

Programas internacionales — Movilidad a Colombia

Aunque varios programas abordan la movilidad de estudiantes colombianos para estudiar en el exterior, la cantidad de estudiantes internacionales que viajan a Colombia ha sido limitada. La discusión en el taller subrayó la necesidad de aumentar el número de estudiantes del exterior para proveer interacciones mutuamente beneficiosas y elevar el perfil de los programas colombianos.

a. **Definir la infraestructura y los recursos requeridos para aumentar la movilidad de estudiantes a Colombia.** Si bien muchas universidades tienen programas académicos muy prestigiosos con la capacidad de aceptar estudiantes internacionales, existen barreras reales y percibidas para los estudiantes que vienen del exterior. Oficinas especiales que trabajen con universidades internacionales aliadas pueden abordar las cuestiones académicas, logísticas, de alojamiento, y otras.

Tema: Alianzas y Redes de Excelencia para la Investigación, la Educación y la Transferencia de Tecnología

Cuestiones identificadas en el taller sobre:
Desarrollo docente

- Programas de doctorado focalizados para grupos que comparten características
  - o Trascender la capacitación "de uno por vez" del doctorado en el exterior
  - o Centrarse en países de habla inglesa (para desarrollar fluidez en la lengua)
- Programas internacionales
  - o Aumentar la movilidad a Colombia
    - ▪ Estudiantes de grado, de doctorado, aprendizaje por medio del servicio comunitario, profesores
- Mentorías en investigación, enseñanza y emprendimientos
- Programa de reingreso (para docentes y líderes empresariales)
- Búsqueda de oportunidades de ir más allá, en lugar de apuntar simplemente a mantenerse actualizado

Recomendaciones: Desarrollo docente

Redes de Excelencia

La investigación y la experiencia indican que las redes establecidas, centradas en áreas de interés entre los involucrados, impactan en el desarrollo de alianzas y programas impulsados por resultados. Las Redes de Excelencia

entre docentes del sistema universitario colombiano, y con universidades y empresas internacionales son necesarias para acelerar programas que promuevan las necesidades de las universidades de toda América. Estas redes posibilitarían que las universidades trascendieran los sistemas existentes y desarrollaran alianzas y programas efectivos para el desarrollo de los docentes.

Programas de doctorado focalizados

a. Desarrollar Redes de Excelencia y alianzas con universidades de América del Norte, Europa y Asia, involucrando a grupos de estudiantes de doctorado, concentrándose en preparar el futuro cuerpo docente para Colombia y la región. Durante el taller se discutió que los *individuos* que buscan un doctorado en el exterior de un modo aislado representan un proceso relativamente ineficiente. Las alianzas que se centran en *grupos de estudiantes* pueden brindar ventajas tanto para los potenciales modelos financieros como para las actividades de desarrollo profesional de los estudiantes, que se extiendan mucho más allá de la experiencia en el exterior. A la luz de las diferencias estructurales entre las universidades en Colombia y en Estados Unidos (Apéndice V), la preparación para un cargo docente o una carrera empresarial en investigación y desarrollo en Colombia puede requerir un conjunto de programas extracurriculares diferente de la preparación para una carrera en los Estados Unidos. Acuerdos más amplios con universidades aliadas permitirían un mayor foco en las actividades requeridas, así como conexiones más sólidas con mentores institucionales en Colombia.

b. **Desarrollar Redes de Excelencia en torno de focos de investigación básica y aplicada.** Para establecer un canal de innovación sustentable, la investigación fundamental o básica debería ser una parte integral del programa general de investigación de una universidad. Una red constituida por las partes interesadas podría identificar áreas de excelencia en investigación básica en Colombia que pudiera alinearse con actividades de investigación en las universidades asociadas. Estas redes podrían permitir un mejor uso de recursos y de las áreas fuertes de investigación, tanto básica como aplicada.

Programa de reinserción para docentes y líderes empresariales

Además de las diferencias en las universidades colombianas y estadounidenses (Apéndice V), hay también diferencias en los ambientes corporativos de investigación y desarrollo en ambos países. En el corto plazo, existe la preocupación asociada con la falta de redes profesionales y técnicas desarrolladas y disponibles para los graduados de maestrías y doctorados que regresan, en particular aquellos a quienes se pedirá que establezcan nuevos temas de investigación o nuevos recursos en sus instituciones.

a. **Desarrollar un programa de reinserción para los graduados de maestrías y doctorados que vuelven a Colombia, que incluya tanto puestos en la universidad como en las empresas.** Un programa de reinserción podría incluir recursos financieros para equipamiento científico, desarrollo de laboratorios, redes profesionales, viajes a conferencias, e infraestructura para administrar la investigación. Idealmente, la institución del exterior donde el estudiante hace el doctorado (a través de una alianza con el director de su doctorado) participaría en la definición e implementación de una estrategia de reinserción y mantendría contacto con el exalumno durante los primeros años de esta nueva carrera.

b. **Desarrollar un programa de mentorías para miembros del cuerpo docente nuevos y en desarrollo.** En las universidades de Estados Unidos, es común que un docente junior tenga como mentor, formal o informalmente, a un colega senior en su área técnica. En los campus donde están ocurriendo transformaciones significativas en el enfoque de investigación, los docentes junior pueden no tener un mentor local en su área técnica, con experiencia de largo plazo en el desarrollo de temas de investigación. Un programa de mentorías, que incluya mentores de Colombia así como de Estados Unidos (o de otros países), es importante para brindar asesoramiento y guía a los docentes junior en los procesos de definir temas de investigación, desarrollar colaboraciones, e identificar el equipamiento y la infraestructura adecuados para el contexto local.

Programas internacionales — Movilidad a Colombia

a. **Definir la infraestructura y los recursos necesarios para aumentar la movilidad de docentes y profesionales a Colombia.** Aumentar las oportunidades para que docentes y profesionales vayan a Colombia y trabajen en el sistema universitario requerirá el desarrollo de infraestructura y recursos adecuados. Debe desarrollarse una propuesta de valor para ambas partes que aliente la movilidad de docentes universitarios y profesionales de otros países a Colombia.

> *Cuestiones identificadas en el taller sobre:*
> *Alianzas de Universidad–Universidad y Universidad–Empresa*
> - Programas conjuntos que involucren a múltiples universidades
> - Compromiso y patrocinio empresarial en programas universitarios
> - Infraestructura de equipamiento compartida, accesible a universidades y empresas

Recomendaciones: Alianzas

Alianzas entre Universidades y Universidad-Empresa-Gobierno

En general, las alianzas de colaboración entre universidades y empresas son menos comunes en Colombia que en Estados Unidos. Además, los recursos de equipamiento e infraestructura para la investigación no suelen compartirse entre universidades ni ser accesibles a las empresas. Si bien las alianzas amplias entre universidades, empresas y gobierno se tratarán en más detalle en futuros talleres, las recomendaciones que aparecen abajo representan los pasos iniciales que deben abordarse en el futuro cercano.

Investigación básica y aplicada

Para establecer un canal sustentable de investigación, las principales universidades de Colombia están tratando de aumentar el alcance y el impacto de sus respectivos programas. Una red integrada por las partes interesadas acelerará el desarrollo de áreas de investigación estratégicas, alineando actividades en universidades aliadas y focalizando programas de gobierno.

a. **Desarrollar Redes de Excelencia en torno de enfoques de investigación básica y aplicada.** Estas redes podrían permitir un mejor uso de recursos y de áreas fuertes de investigación, tanto básica como aplicada.

b. **Desarrollar políticas públicas y financiamiento que promueva áreas de investigación estratégicas.** Los gobiernos deben garantizar que se desarrollen buenos procesos de revisión de pares. Líderes no gubernamentales respetados deberían identificar áreas de investigación estratégicas donde invertir. El apoyo a las áreas elegidas debería trascender los cambios en el liderazgo de los organismos y los gobiernos, para que los esfuerzos sostenidos puedan seguir contando con apoyo.

Infraestructura de Investigación Compartida

En Estados Unidos, un modelo común empleado para financiar equipamiento de infraestructura es el "centro de costo". En este modelo, el equipamiento es operado como una "instalación para usuarios", en la que una serie de usuarios (internos y externos) tiene acceso al equipo. Estos pagan un monto por usar el equipo y la suma total recaudada en un año suele cubrir los costos generales de su operación y mantenimiento. Un modelo así podría ayudar a que las instituciones colombianas crearan infraestructura de equipamiento esencial relativamente rápido y redujeran la necesidad de replicar sistemas en cada universidad.

a. **Evaluar las barreras legales y culturales para los "centros de costo".** Considerando la percepción de que las empresas no tienen autorización para usar las instalaciones universitarias, es importante comprender si un

modelo de centro de costo es aceptable legal y culturalmente en Colombia.

b. **Evaluar a los usuarios potenciales en el ámbito local que compartirían algunas piezas representativas o múltiples equipos de infraestructura.** Los usuarios locales incluirían universidades, empresas y el gobierno, o laboratorios patrocinados de manera privada.

Alianzas Empresa–Universidad

Para fomentar la investigación, el desarrollo y las actividades de transferencia de tecnología con empresas, es importante establecer una infraestructura que permita que los grupos de investigación de la universidad y los grupos corporativos de desarrollo interactúen libremente. Una Red de Excelencia podría asistir en esta transformación. La infraestructura y acuerdos estándar pueden abordar cuestiones asociadas con licencias, confidencialidad y propiedad intelectual desarrollada en el contexto de programas de colaboración.

a. **Desarrollar una infraestructura para las licencias de propiedad intelectual y la transferencia de tecnología de las universidades a las empresas.** Las oficinas de comercialización de tecnología se concentran en publicitar la cartera de patentes disponibles y negociar los acuerdos de licencia entre la universidad y las empresas.

b. **Definir acuerdos estándar entre universidades y empresas relacionados con propiedad intelectual, licencia de patentes y transferencia de tecnología.** En particular en casos que involucren investigación patrocinada por empresas, son esenciales los acuerdos "por adelantado" para crear programas sólidos. Un acuerdo estándar existente entre una determinada empresa y una universidad puede establecer un marco para que el trabajo patrocinado o en colaboración pueda comenzar rápidamente con cada nuevo proyecto, y que necesite solo una declaración de trabajo y un presupuesto.

Definir áreas para Alianzas Universidad-Empresa en Investigación y Educación

Se recomienda como área de enfoque para un segundo taller la definición y creación de alianzas relevantes, exitosas y sustentables.

Tema: Ecosistemas de Investigación

Cuestiones identificadas en el taller sobre: Comercialización

- Construir centros de innovación y comercialización en Colombia
  - Vincular investigación y comercialización
- Crear una cultura de la innovación (por ej., que se refleje en toda la universidad)
- Programas de emprendimiento
- Licencias de PI (en particular de Estados Unidos a Colombia)
- Alianzas de Empresa-Universidad: Definir propuestas de valor para inversiones de empresas en programas de la universidad

Recomendaciones: Comercialización

Para aprovechar al máximo los programas de investigación de la universidad, deberían apoyarse las actividades de comercialización, incluyendo patentes, programas de emprendimiento y transferencia de tecnología a empresas. Si bien una variedad de alianzas empresa-universidad tiene potencial interés, las recomendaciones específicas en esta sección se centran en las licencias de propiedad intelectual y los acuerdos que puedan fomentar inversiones en programas universitarios de investigación.

Políticas de propiedad intelectual

a. **Evaluar las políticas actuales de propiedad intelectual y los programas de incentivos asociados a éstas.** En general, las patentes surgen de proyectos de investigación, y el proceso de patentamiento es iniciado por los investigadores que lideran el proyecto o, quizás, por el impulso del patrocinador. En este escenario, la universidad debería establecer políticas y recompensas adecuadas para alentar a los grupos de investigación a patentar expeditivamente resultados prometedores.

Programas de emprendimiento

Un camino hacia la comercialización implica que los docentes y estudiantes inventores creen nuevas empresas. En este caso, los fundadores de la compañía obtendrían típicamente la licencia de las invenciones de la universidad y luego obtendrían financiamiento inicial independiente. Como la mayoría de los miembros del cuerpo docente no están entrenados para comenzar una empresa, es necesario brindarles capacitación y actividades de mentoría para estos esfuerzos.

a. **Crear programas de capacitación en emprendimientos**. Los programas de capacitación focalizados en las cuestiones técnicas, comerciales y financieras de comenzar una empresa pueden ayudar a fomentar emprendimientos, así como identificar potenciales emprendedores.

b. **Definir un programa de incentivos que aliente a los docentes, el personal y los estudiantes a participar en actividades de innovación y transferencia de tecnología.** Comenzar una empresa puede llevar varios años de esfuerzo. Esta es una tarea difícil incluso para alguien sin responsabilidades de enseñanza, investigación y servicio de tiempo completo. Incluso transferir una tecnología a una empresa ya establecida puede requerir una significativa cantidad de tiempo y esfuerzo. Los profesores, el personal y los estudiantes necesitarán disponibilidad de tiempo y potencialmente otros recursos.

c. **Desarrollar un programa de mentoría para potenciales emprendedores.** Los emprendedores experimentados (de Colombia y el exterior) pueden ser una valiosa guía para las personas que intentan comenzar una empresa.

d. **Identificar recursos relativos a la comercialización para potenciales emprendedores.** Los investigadores universitarios suelen comprender su tecnología, pero rara vez entienden los aspectos financieros, comerciales, productivos o legales de un negocio exitoso. Personal local bien versado en estas actividades podrían ser los directores ejecutivos o financieros de las nuevas empresas y requerir una participación en el capital de la empresa.

Conclusión

Un resultado claro de este primer taller indica que todos los participantes tienen un interés personal en continuar el diálogo con una participación más amplia de partes interesadas fundamentales, incluyendo el gobierno, ONG y empresas. Hay una fuerte sensación de urgencia para actuar realizando cambios dentro de la estructura universitaria y tener más capacidad de respuesta antes las necesidades del siglo XXI en toda América. Conscientes de que las colaboraciones y las alianzas son esenciales para facilitar el cambio de esta escala, se han propuesto Redes de Excelencia para acelerar el

proceso. Las Redes de Excelencia crean un ambiente que reúne diversos puntos de vista, experiencias y conexiones, necesarios para posibilitar el tipo de cambios transformacionales que llevan a una economía innovadora basada en el conocimiento.

[1]Nota a pie de página 6

Bajo la ley Morrill (1863), el gobierno de los Estados Unidos otorgó una parcela de tierra a cada estado. Las ganancias provenientes de la venta de esta tierra debían usarse para establecer al menos una universidad dedicada a brindar una educación práctica a la clase trabajadora, incluyendo programas en "agricultura y las artes mecánicas". (Esto último es lo que hoy se conoce como ingeniería y tecnología). Aunque estas universidades, llamadas "Land Grant" ("por cesión de tierras"), han evolucionado significativamente, a menudo incorporando disciplinas ajenas a la agricultura e ingeniería, el foco en una educación práctica y accesible sigue siendo un componente fundacional. Estas universidades también han tenido un papel activo para impulsar el desarrollo económico y ofrecer recursos a los residentes del estado, a través de programas de compromiso con la comunidad. Estos incluyen servicios de extensión agrícola y para la industria y el gobierno, investigación dirigida a necesidades sociales, y programas para la transferencia y comercialización de tecnología.

Appendix I

Framing Statement and Advanced Workshop Overview

Framing Statement

Peace, *prosperity* and *sustainable development* in the Americas are critical goals for robust economies and functioning governments. How can the University of the Future prepare global leaders who are ready to meet this challenge?

Common Understanding

"Conversatorios" on a few select topics, with the understanding that:

- We are seeking new initiatives that build upon, or advance beyond, the existing status quo for universities.
- In addressing the challenges facing universities, we value a collaborative framework to cross-cutting themes such as preparing future faculty, financing, and the required infrastructure.
- We recognize this is a collective effort – no one institution can do this alone; nor can universities tackle this comprehensive effort without the active engagement of the private sector, government, and international partners.
- We are committed to addressing these challenges with sustained and sustainable efforts, and intend to continue both the conversations and programs over the long-term, with regular follow-up workshops.

Specific Workshop Goals

- Consider national/regional/global contexts for educational, research and innovation initiatives (to be highlighted in keynote and invited presentations and plenary remarks).
- Share examples of successful programs as best practices, as well as challenging problems (participants are asked to provide input both in response to an advance questionnaire and in informal remarks at the Workshop as seeded by lead presenters).
- Identify common issues and opportunities for partnering (all participants), including opportunities for partnering to address the need for greater financial resources for the universities and their faculty and students.
- Discuss frameworks for educational innovations, collaborative networks, and innovation ecosystems (all participants).
- Generate position papers and policy proposals to be distributed to institutions, companies, governments, NGOs and the media to effect broader systemic solutions and longer term opportunities.

Key Follow-Up Activities

- Forum report on *University of the Future* and framing of key issues for future events.
- Next workshop (six months) in Colombia with a regional focus, with Colombia as a hub.
- Explore specific partnerships and networking frameworks.

- Explore joint funding opportunities.

Thematic Areas

The two-day workshop will include participation from knowledgeable leaders of universities, companies and government agencies in Colombia and the US. While national initiatives provide long-term frameworks, the workshop will focus on institutional goals, challenges and opportunities in thematic areas: Transformative Education, Innovation/Commercialization and Partnerships and Networks for Excellence in Research, Education and Technology Transfer. A number of issues are expected to be cross-cutting themes within the sessions, including student programs, faculty development and sustainable financial models.

Session Format

Sessions will include keynote talks and brief introductory presentations by Colombian and Purdue representatives, primarily aimed at framing potential topics and raising key questions. The introductory presentations will be followed by 60-90 minutes of open discussion. In the spirit of a *conversatorio*, we hope to encourage a spirited and frank conversation involving all participants, in preference to prepared remarks. The proposed thematic areas are relatively broad, in order to allow participants to define specific topics for discussion. Simultaneous translation will be available, so that remarks can be made either in Spanish or English and participants will be able to listen in either English or Spanish.

Purpose/Outcomes

The event is expected to provide a forum for conversations related to key goals, challenges and opportunities for transforming higher education. One of the outcomes of the workshop will be a position paper that will summarize the key goals, opportunities and challenges for universities and provide a framework for strategic partnerships to accelerate progress. This position paper will be distributed to participants and can be shared with government and corporate leaders in order to encourage programs and investments addressing the key issues.

Purdue's Role in Workshop

Purdue professors and senior officials will be participants in the focused discussion sessions. While specific Purdue programs and existing partnerships are likely to be mentioned in the discussions, the workshop will focus on a broader dialog regarding future goals, challenges and opportunities. Like universities in Colombia, Purdue strives to serve the needs of our country and our state and we are transforming to be relevant for the 21st Century. We anticipate a series of frank and open conversations in which we discuss our challenges as well as our successes, and we expect to learn from Colombian participants.

Appendix II

Workshop Agenda

Tuesday, 28 October

7:30 am   Shuttle Bus departs Union Club Hotel lobby entrance

                 Coffee and light breakfast will be available at the Kurz Center

8:00 am   Session I: Framing the Workshop (Kurz Center)

                 Welcome and Framing Presentation -- Suresh Garimella, Executive Vice President for Research and Partnerships, Purdue University

8:20 am   Session II: Transformative Education (Kurz Center)

                 Framing Presentation -- Frank Dooley, Interim Purdue Vice Provost for Undergraduate Academic Affairs, with participation by Ananth Iyer, Director of Purdue NExT

11:15   Keynote – Company/University Partnerships (John McDonald, GE)

11:40 am   Shuttle Bus departs Kurz Center for Purdue Memorial Union Union (PMU)

12:00 pm   Lunch with Colombian Students at Purdue (CSAP) (East Faculty Lounge, PMU)

                 12:40 Introductions/Brief Presentations by Colombian Students

                 1:00 Importance of Education in Colombia and US-Colombian Partnerships: *Luis Carlos Villegas, Colombian Ambassador to US (*with participants and students*)*

1:30 pm   Extended Discussion with Ambassador Villegas (Anniversary Drawing Room, PMU)

2:00 pm   Session III: Innovation/Commercialization – (Anniversary Drawing Room, PMU)

                 Framing Presentation: Dan Hasler, President and Chief Entrepreneurial Officer, Purdue Research Foundation, with participation by Joseph Pekny and Nathalie Duval-Couetil, Burton Morgan Center for Entrepreneurship, Purdue

                 Framing Presentation: Juan Camilo Quintero, Director, Ruta-N

4:30 pm   End of sessions; participants may return to hotel rooms

6:15 pm   Shuttle Bus departs Union Club Hotel lobby entrance

6:30 pm   Hosted Dinner and Plenary Remarks with Purdue President Mitch Daniels

9:00 pm   Shuttle Bus departs dinner, returns to Union Club Hotel

Wednesday, 29 October

7:30 am   Coffee and Light Breakfast available in Anniversary Drawing Room, PMU

8:00 am   Session IV: Partnerships and Networks for Excellence in Research, Education and Technology Transfer (Anniversary Drawing Room, PMU)

                 Keynote – Anne Slaughter Andrew (former US Ambassador to Costa Rica)

Framing Presentation -- Gerhard Klimeck, (Electrical and Computer Engineering) Network for Computational Nanotechnology

Framing Presentation – Michael Ladisch, (Agricultural and Biological Engineering/Biomedical Engineering) Laboratory for Renewable Resource Engineering

11:00 am   Session V: Reports on Discussion Sessions and Future Pathways

12:00 pm   Lunch with Purdue Participants and Delegations (East Faculty Lounge, PMU)

1:30 pm   Colombia Purdue Institute Agenda – Participants and accompanying delegations.

Appendix III

Advance Questionnaire

Overview of Advance Questionnaire

In advance of the workshop, a questionnaire was distributed to all participating institutions. Participants were asked to provide up to three (3) priority areas or top goals/challenges in each of the following areas:

- Transforming Undergraduate Education
- Priorities for Faculty Member Skills
- University Research Programs
- Innovation and Commercialization
- Partnerships, including single institutions, networks consortia and public/private

The full questionnaire is provided in this Appendix.

The responses to the questionnaire were compiled and a summary of the responses was presented at the workshop. Participants were asked to comment on the summary. Common themes from written responses as well as comments by participants were incorporated into the overall workshop summary.
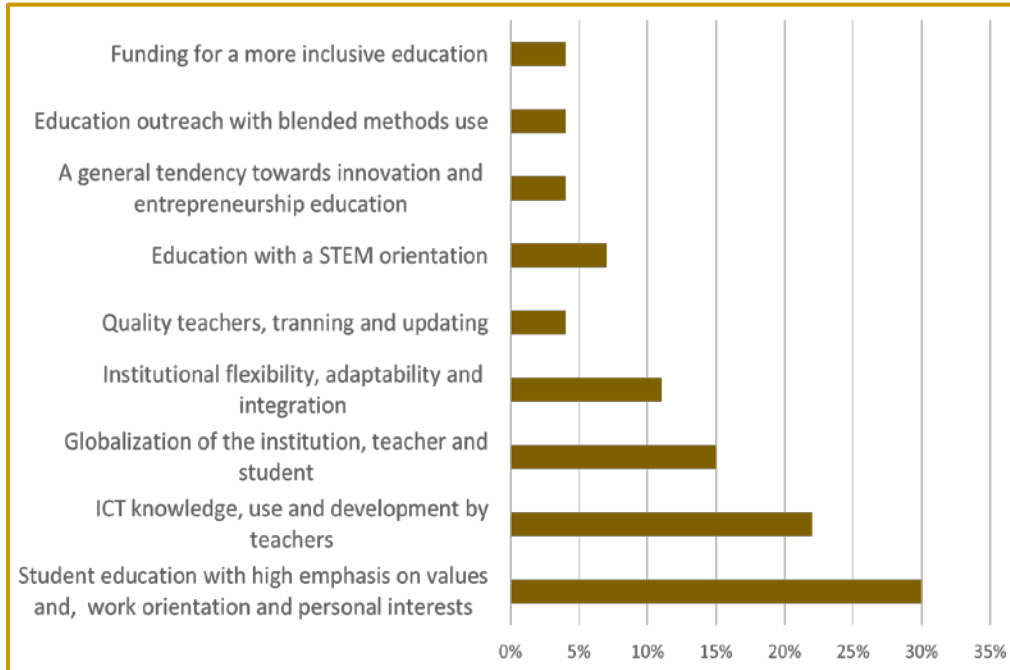
Summary of Questionnaire Responses

The questionnaire responses have been grouped according to common themes, and tabulated in terms of frequency of a given category of response. The charts below present a summary of the compiled responses. Since each institution was asked to provide up to three items in response to each question, the responses to a given question may total above 100%.

There were insufficient responses to the question on institutional partnerships to allow generation of a representative summary.
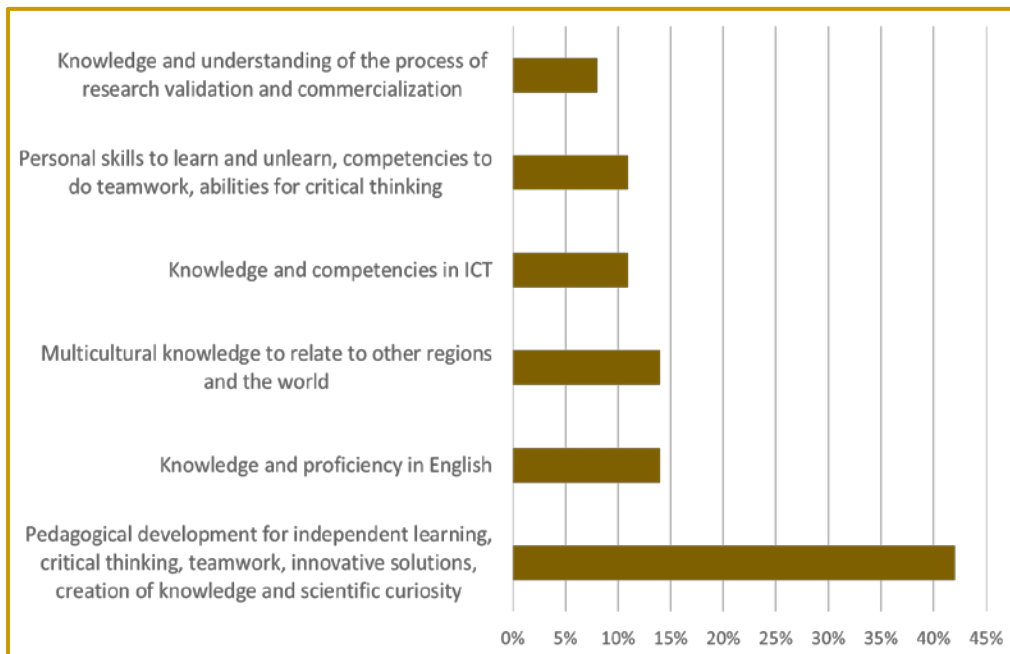
Transforming Undergraduate Education

Which are your three priority issues for transforming undergraduate education?
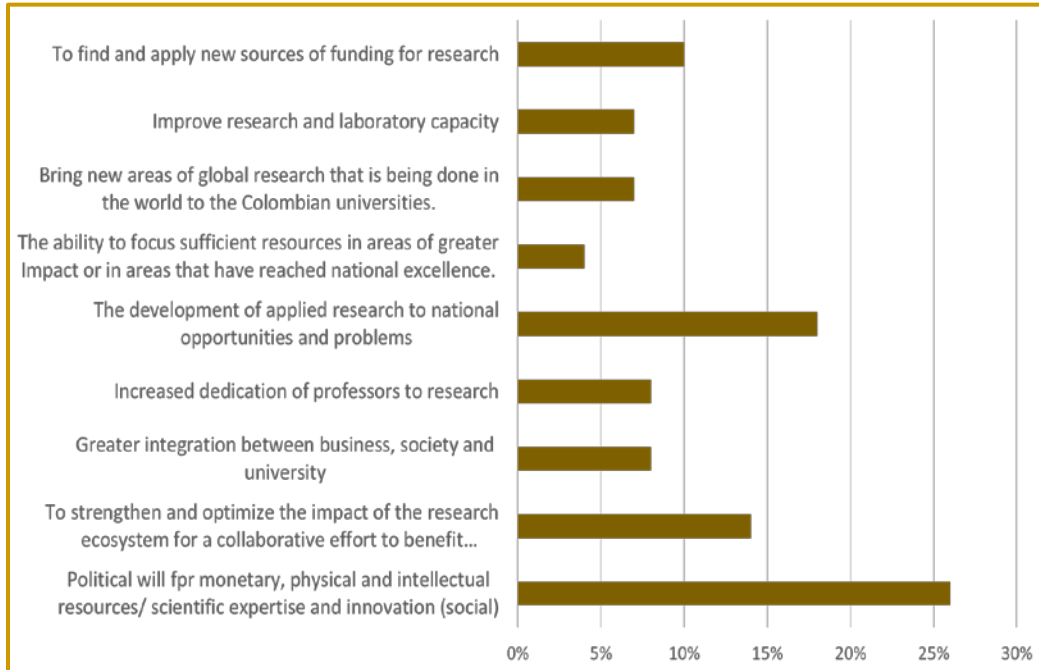

Priorities for Faculty Member Skills

What are the primary skills required for future faculty members (professors, instructors)?
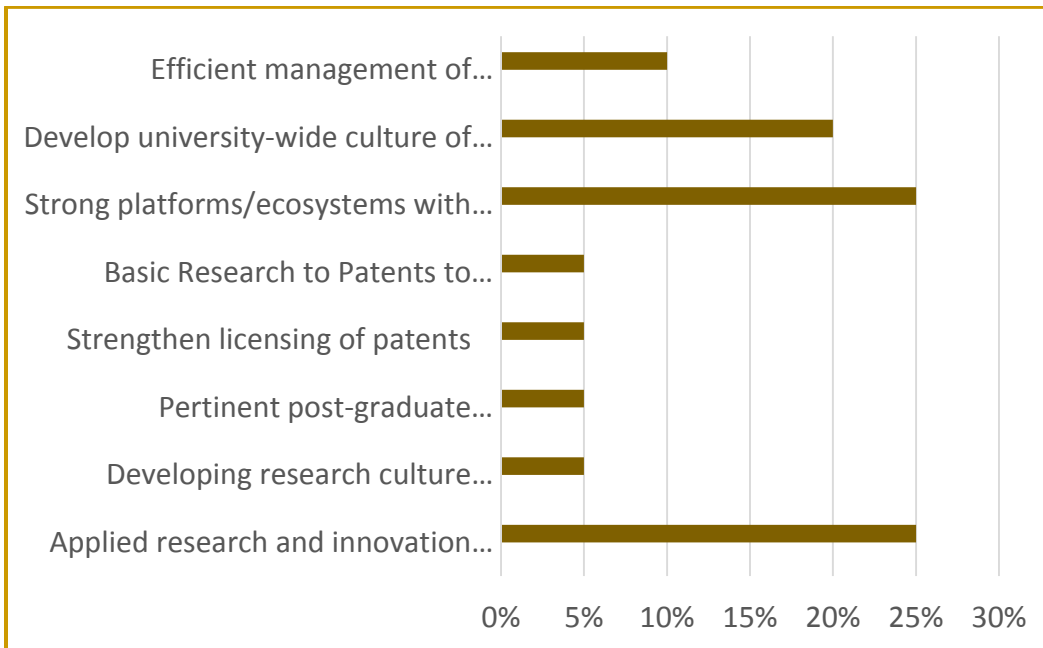
University Research Programs

What are the key opportunities and challenges for university research programs?

Innovation and Commercialization

What are your institution's key goals and challenges in Innovation and Commercialization?

Text of Advance Questionnaire

The University of the Future, a workshop led by Purdue University

Questions for educational, senior business and government leaders

In today's ever changing world, higher education is called to constantly redefine, redesign and reestablish its value proposition. Globalization of businesses and markets, financial melt downs, shortcomings in value systems, the fast-changing nature of organizations with innovation and entrepreneurship as constants, changing generation of people who perform various roles (Gen X, Gen Y and Gen Z working under the same roof), increased access to technology and ever changing technology and communications, emerging countries housing global businesses require new roles to be performed by universities, new skills to be developed in the student and future professionals and effective networks in order to articulate a more pertinent education.

This is the challenge for all countries and in the case of Colombia; there is an important shared purpose to better the quality of education in general and prioritize the advancement of science and technology and innovation and entrepreneurship. The role of the Colombian leaders in the creation of shared value is critical, and even more important is the coming together of educational, senior business and government leaders.

More broadly, peace, prosperity and sustainable development is critical to all of the Americas. Universities throughout the Americas represent ideal points for exchange of people, ideas and approaches and will play key roles in developing partnerships that can address regional/global challenges. Ideally, universities, businesses and government will work collaboratively toward developing the next generation of leaders prepared to address regional/global challenges in education, innovation and collaboration.

We propose to offer a space where these topics can be exposed, discussed and from where co-creation will emerge.

We greatly appreciate your cooperation as one of those leaders who will actively participate in this two-day workshop on the areas of discussion chosen: Undergraduate Education, Research, Innovation/Commercialization and Partnerships (Multi-institutional, international and public/private).

Your thoughts will go a long way in helping this workshop redefine future areas of shared growth for all. A few questions are included below. While the questions are mainly aimed at Rectors, participants from companies, agencies and NGOs are also invited to respond, in order to provide your perspectives on potential programs and partnerships.

In addition to the formal questions, we would be very interested in learning about either an initiative/program that has worked well or a key challenge that you are facing. Please provide a ~ 300 word summary of either a successful program or key challenge in the topic of your choice.

These summaries will be instrumental in the moderated discussions as well as the workshop report.

Questions

Brief description of a successful program or key challenge in one of the workshop focus areas (~ 300 words or less):   *Narrative description from participants*

1. Which are your three priority issues for transforming undergraduate education?

2. What are the primary skills required for future faculty members (professors, instructors)?

3. What are the key opportunities and challenges for university research programs?

4. What are your institution's key goals and challenges in Innovation and Commercialization?

5. What are your goals/expectations for partnerships with:

    a. Single institutions

    b. Networks/consortia

    c. Public/private entities

Thank you for your ideas and welcome to the workshop.

Appendix IV

Post-workshop Structured Interviews

Text of post workshop structured interviews

University of the Future

Questionnaire II

A Workshop led by Purdue University

<div style="background-color:#8a7620; color:white; padding:4px;">**Questions for University and Institutional leaders**</div>

After the University of The Future workshop took place October 28-29, along with tours and individual engagement with many at Purdue, we would like to have your feedback on the event and gather your ideas on possible next steps. We appreciate your feedback which we consider most valuable for the advancement on the topic of the University of the Future and as a way to deepen our mutual relations and establish actions that your institution and the group of participants would like to carry out individually, as joint projects and as collective projects that that you can lead for the benefit of higher education in Colombia and in the Americas. We appreciate your comments.

We would also like to define one or two projects that will become examples of action taken and that would be presented in our second workshop in a few months in Colombia. Finally, the information gathered will be part of the white paper that we will jointly develop to present to other Colombian universities, business and government.

<div style="background-color:#8a7620; color:white; padding:4px;">**The event's outcomes**</div>

Ideas were generated based on the exposition of *Purdue Moves*, where the university's faculty, staff and administration work together to make higher education more affordable and value-added, provide new opportunities for students, address problems of national and global significance, and contribute towards economic development locally and regionally.

The group came together in a spirit of working and thinking collaboratively striving to build on and spread the important partnerships developed with Colombia.

All of the workshop participants focused on four areas of transformation:

- Teaching and learning, including content and processes.
- Developing the "whole student" beyond just technical knowledge.
- Faculty development, including focused doctoral programs, international programs and mentoring.
- Fostering commercialization through existing innovation centers and new entrepreneurship programs.

Questions

Now we would like to hear your impressions on several of the topics mentioned above.

6. What do you consider to be the most significant experience you brought back from the workshop?

7. Of the following topics, which are of major interests for your institution?

a.   _____ Teaching and learning methods
b.   _____ The methodology of doing basic and applied research
c.   _____ Revision of Educational programs
d.   _____ The research centers and labs
e.   _____ Student and faculty mobility
f.   _____ Transfer of knowledge from Purdue to your institution
g.   _____The possibility of developing shared research in science and technology
h.   _____ The commercialization of academic knowledge in America
i.   _____ A network that interacts in joint projects for the benefit of developing higher
         education
j.   _____ Other
8. Of the above areas of interest, which three are part of your institutions strategic plan?
a.
b.
c.
9. Of the above, which would you like your institution to actively participate?
a.
b.
c.
10. Of the above, which would you like to develop between your institution and Purdue?
a.
b.
11. Of the above, which would you like to work on regionally?
a.
b.
12. Of the above, which would you like your institution to lead in your city and community?
a.
b.
13. Of the above, which would you like to lead for Colombia?
a.
b.
14. Of the alternatives chosen, what are your priorities?
a.
b.

15. On the topic of learning and teaching, what are your primary interests?
    a. _____ Evaluate and transform teacher learning
    b. _____ Send faculty to Purdue so they can better their teacher competencies
    c. _____ Study and implement new methods in teachers teacher and student learning
    d. _____ Integrate Purdue methods of teaching to your institutions methods
    e. _____ Lead a workshop on methods of teaching during the following months
    f. _____ Establish a learning and teaching center for faculty
    g. _____ Establish a program for the transformation of teaching on a national scale
    h. _____ Pursue blended learning program
    i. _____ Design and implement virtual learning programs for teachers

16. On the topic of research, what are your main interests?

    a. _____ Establish a research program on specific topic:
    b. _____ Evaluate and compare basic and applied research processes and methodologies
    c. _____ Study and propose joint research projects in the topics of:
    d. _____ Connect with industry for applied and joint research projects
    e. _____ Complement projects that are underway
    f. _____ Use Purdue laboratories for research projects
    g. _____ Do regional, national and global commercialization of research
    h. _____ Lead commercialization efforts in research and education
    i. _____ Do applied and joint research projects on Colombian problems
    j. _____ Send researchers to Purdue for hands on experience and research
    k. _____ Bring Purdue researchers to Colombia to work on teaching and research
    l. _____ Look for scientific and technological solutions applied to Colombia
    m. _____ Work on joint social innovation programs
    n. _____ Look for joint research funding

17. On the topic of education programs, what are your main interest?

    a. _____ Transform program contents
    b. _____ Develop shared courses with Purdue
    c. _____ Develop educational programs in other regions of Colombia
    d. _____ Bring in foreign students to your programs
    e. _____ Send students for credit programs to Purdue
    f. _____ Bring Purdue Students to your university
    g. _____ Develop English as a foreign language for your students
    h. _____ Send students for entrepreneurs certificate programs or courses to Purdue
    i. _____ Do joint executive education for the business community
    j. _____ Start a shared virtual education network
    k. _____ Globalize the contents of your programs

18. On the topic of infrastructure, lab facilities, what are your main interests?

    a. _____ Construct new research facilities in your campus with Purdue assessment?

b.   _____ Construct new research labs to share with other institutions?

c.   _____ Use Purdue's Research Park to do research?

d.   _____ Develop joint research projects in other cities in Colombia?

e.   _____ Learn how Purdue does research and apply it to your institution?

f.   _____ Study how students can be better motivated and involved in research?

g.   _____ Lead the committee that analyzes how to better research in the region?

Other topics

19.   When do you suggest we hold the next workshop?
20.   Who do you suggest we add to the list of participants?
21.   In what city do you consider that the worskshop should be held in?
22.   Would you assist?
23.   What are the three main experiences that we could be working on starting now?
a.
b.
c.
24.   In addition to presenting the ongiong projects, what other topics should be considered and what conferences (short 15 minutes) should be included?
25.   What activities should the workshop include?

Thank you for your active participation and the time you have given us to advance the definition of joint projects that can better the quality of education in Colombia!

Appendix V

Comparison of US and Colombian University Systems

Overview
This section summarizes the similarities and difference between US and Colombian university systems, government funding models, and typical corporate interactions with universities. While not an explicit theme at the workshop, aspects of this comparison were implied in a number of comments and questions. It is important to understand the similarities and differences between the systems in the two countries in order to develop partnership activities with mutual benefits that are consistent with local programs and funding models. More broadly, the comparison is essential for the transfer of existing programs and "best practices", particularly in terms of evaluating which activities fit within existing systems and which will require structural change.

US Universities, Funding Systems and Company Partnerships
Major US Universities are Research Universities
After World War II, the US government placed a high priority on research and development, initiating major transformations for US universities to become research universities. This transformation has aided the US in defining and maintaining a position of leadership in science and technology. Most major universities in the US now share common attributes, including:
- Broadly focused on "research, teaching and engagement/service," with each faculty member participating in all three components of the mission.
- Research budgets are a significant fraction of overall university budgets.
- Rankings of graduate programs are based on research funding, prestige of faculty (*e.g.* national academy members), and peer rankings.
- For faculty members (professors), research is an integral part of their career.
- Major criteria for promotion/tenure are:
    - establishing an independent research program, and
    - recognition in the technical community.

Opportunities/Pathways for Higher Education
In addition to major research universities, many states have other public and private universities that serve the needs of a broad population. Public options include either branch campuses of leading universities or "compass point" universities (with more of a focus on undergraduate and MS programs), junior/community colleges offering two-year programs, either as stand-alone degrees or in preparation for a four-year college/university, and perhaps technical/vocational training programs. Private colleges and universities exist in many cities, and offer programs in various disciplines. In large cities, colleges and universities can serve both traditional and non-traditional students by providing night courses, weekend programs, and executive programs.

Faculty Roles

Faculty at all ranks are expected to establish and maintain independent research programs. Junior faculty do not formally report to senior faculty, and are expected to define research themes that are distinct from those of their major professors, as well as their senior colleagues, and to obtain independent funding. While collaborative efforts are important, each faculty member needs to be a strong individual contributor.

Effectively, each faculty member is a small businessperson, responsible for acquiring external funding for their research program, supervising graduate students and defining collaborations (internally and externally).

New faculty are typically hired from outside the university, with searches considering a nation-wide/international pool of candidates. Searches typically focus on candidates from top discipline specific programs with an aim to strengthen and diversify research capabilities.

Research Funding in the US

Through federal and state funding, along with investments from companies and non-governmental organizations, there is significant investment in research and development. While a portion of this funding goes into basic research, an important fraction of the funding is aimed at addressing problems of national or global relevance, or priority areas for mission-driven agencies. Research grants provide support for graduate/postdoctoral students and other research staff, partial salary support for participating professors, laboratory expenses, scientific equipment and travel associated with the project.

Attributes of particular relevance to universities include:

Funding sources:
- Majority of funding comes from "external" sources (Federal government, companies, or international agencies. A smaller fraction comes from state, local or internal funds.
    - Federal: competitively-awarded grants (generally peer-reviewed), through multiple agencies, ranging from basic research through applied R&D (typically through mission-focused agencies)
- Federal Grant awards typically cover costs of stipends for graduate students, laboratory costs/fees, travel for program reviews or conferences, and partial faculty salaries (for summer support and a portion of academic-year salary). Funding may also cover costs of research staff and scientific equipment.
- Research grants are administered independently by faculty investigators, with financial support from sponsored programs and business offices. Funds are held separately from the main university budget.

Research infrastructure:
- Can be operated as cost centers – allow usage by multiple users, including external (academic and corporate).
- Funded through faculty start-up packages, external grants, gifts.

Graduate Student Support and Dual-Role as Students/Researchers/Teaching Assistants

Graduate students are an integral part of research and teaching programs at major universities. These students generally serve in dual roles, both as students receiving training in their respective disciplines and as contributors to the research, and through education and engagement missions of the university.

Graduate student support: While some grants are given directly to students (*e.g.,* National Science Foundation or Department of Defense fellowships), the majority of graduate student support is provided to faculty investigators in standard grants. The investigator then identifies a suitable graduate student to work on the project. While citizenship requirements typically apply to fellowships and sometimes to applied R&D projects, grants for basic research frequently allow support of international graduate students.

- Dual role as students and researchers/teachers: During the course of a PhD or MS degree program, students are considered both students, and researchers or "teaching assistants". This has several consequences:
  - o The individuals are registered as students, receive access to student services, and take classes (during a portion of their degree program).
  - o Students employed as research assistants (RAs) or teaching assistants (TAs) are considered part-time staff of the university, and receive a stipend paid through the university (for RAs, the stipend is typically funded by an external grant).
  - o RAs participate in the research mission of the university; collectively, thesis research projects make a significant contribution to the scholarly output of the university, including journal publications, conference presentations, patents and technical reports.
  - o TAs participate in the teaching mission of the university, through serving as lecture and laboratory assistants. Advanced TAs may also teach courses, although the majority of courses are taught by faculty. TAs may also be involved in thesis research work, or other research projects.
  - o Students supported as RAs or TAs do not pay tuition. The grant supporting the student is charged a "graduate fee remission" in lieu of tuition. Consistent with the dual role of the student, the cost charged to a grant (for graduate fee remission) is typically less than the tuition rate.

Undergraduate Programs

Most major US universities also include significant undergraduate populations. For example, major public universities in the Midwest may have over 30,000 undergraduates and 5,000-8,000 graduate students. In the case of public universities, undergraduate education for state residents is typically the major motivation for funding provided by the state as well as a major source of external visibility. Faculty and teaching assistants are actively involved in teaching of undergraduate courses.

- Most major universities in the US have extensive international programs, including both study-abroad programs and large international-student populations. Universities typically have dedicated international program offices that provide resources to support these efforts.

US universities are located in both major cities and smaller towns. The local context, in terms of housing, local transportation and campus construction, varies significantly between major cities and smaller towns. Particularly in major public universities, it is common for undergraduate students to live on or near campus, and rely on the resources/infrastructure of the university or perhaps a near-by campus town for their housing, meals, healthcare and local transportation.

Commercialization

Universities play a significant role in commercialization largely leveraged by the research infrastructure and demonstration of basic concepts in university laboratories. Specific commercialization activities typically are based on patents, and are commercialized either through licensing/technology transfer to an established company or through a start-up effort including faculty/students involved in the invention.

Patent ownership: The Bayh-Dole Act allowed universities/companies to patent research performed under US government funding. This Act represented a fundamental change in the commercialization of research. The licensing to companies is handled through offices of technology commercialization.

Faculty or student start-up companies can license patents from the university (typically inventions by principals in a company). This allows opportunities to apply research results to practical problems. In addition, there is potential for significant financial pay-off (equity stake in company).

Company/University Partnerships

Many US and multinational companies look to universities for well-trained students, as well as innovations, expertise and specialized programs. In order to foster these activities and the links to universities, companies support research or education programs.

Company sponsorship of educational programs/laboratories at universities:
- Helps prepare students well-versed in areas of interest to companies

Company-funded research grants (basic or applied research)
- Leads to research results as well as potential employees

Patent rights negotiated at start of grant/contract
Universities address problems of relevance for companies through:
- Company-funded research programs
- Government sponsored programs (some research programs, including centers, require relevance to companies, and perhaps direct investment from partner companies)

- "Public/Private" partnerships: joint programs between government, companies, often involving universities:
- Joint investments leverage resources, provide benefits for companies and country
- Universities (public or private) can contribute expertise, educational programs, public outreach

Colombian Universities, Funding System and Company Partnerships
Overview of Colombian Universities
While Colombian universities are committed to transformation toward the research university model, they are relatively early in this transformation. The traditional role of Colombian universities has been focused on undergraduate education and master's degree programs.

Access to Higher Education
The Colombian education system does not have the capacity to accommodate a growing demand of graduating high school students. There are no community colleges and until recently, very few technical or technological institutions that met standards of higher education. Equally important, the demand for education has different results depending on student resources. Students with the financial means generally apply to private universities, while students lacking the financial ability to pay for a private university must compete for a scholarship at a private university or compete to study in an official (public) university. In both cases there is a shortage of capacity at universities to guarantee that the demand is met, and that the quality of education is equivalent between the two types of institutions. Many private universities in Colombia have high-ranking programs staffed by professors with excellent qualifications, modern and efficient classrooms, and research laboratories; resources in publicly funded universities, on the other hand, may be scarce. These disparities may sometimes result in lower rankings, and inefficient campuses which affect the quality of education. With a few possible exceptions, funds allocated by the government are not sufficient to improve the research infrastructure of many of the public universities. There is an effort underway for the central government to substantially increase resources for education; Information and Communications Technology is among the priorities for the government of Colombia.

Faculty Roles
Most universities have professors with PhD degrees and instructors with MS degrees, with the ratio between professors and instructors varying from university to university. The relative prioritization of teaching, research, and service programs varies from university to university. On average, approximately 70% of a professor's time is dedicated to teaching and extension activities (such as in company training and consulting), while 30% is dedicated to research which is frequently funded by the university. In many cases the senior professors have been involved mainly in teaching, with the transition toward a research focus occurring relatively late in their careers. The lack of incentives for faculty research has a direct effect on the motivation and dedication to applied research and innovation.

The aspiration of Colombian universities to transform into research institutions underlines the importance of new approaches that must be adopted to encourage change. Recent studies on the importance of the role of the faculty in the quality of education have determined that it is critical to change the culture related to the teaching profession and to expand teaching and research incentives. With the exception of PhD students, and professors with doctoral degrees, many of the faculty do not integrate undergraduate students in their research, nor do they emphasize the importance of research in the classroom.

Since many higher education institutions offer low salaries and incentives for teachers in comparison to other professions in Colombia, higher education as a career is not the preference of qualified candidates with advanced degrees.

Research Funding in Colombia

R&D investment in Colombia (including corporate R&D and university/research laboratory funding) represents a much smaller share of GDP than in the US.

Colciencias, the Colombian science foundation, is the government institution that provides funding for research projects and grants. It has two basic purposes: to fund research, and to give grants for post graduate studies with an emphasis on PhDs. The largest portion of the resources available is dedicated to student grants, leaving few resources for research projects. A fundamental element lacking in the research community is the existence and availability of laboratories and facilities; this requires significant investment on the part of public universities. Private universities are improving their capacity in this regard, but since public universities rely on government allocations of funds, capacity improvement is difficult to implement in the near future. The range of agencies funding university research is much more limited than in the US.

Funding to stimulate universities to make advancements in matters of science, technology, innovation and entrepreneurship is essential. While Colombia falls behind in basic and applied research, there is growing awareness of the need to advance. Recently, Colombia's government committed a fraction of the energy and mining royalties (*Regalias*) to be used to fund R&D; state governments are tasked with deciding upon strategic areas and processes for distributing these funds.

A 2009 law in the System of Science, Technology and Innovation (CTI) seeks improved impact on Colombia's commercial sector. To meet this objective, strategies exist for increased interaction among international and national scientific communities with the commercial sectors of the economy. The result has been increased motivation for researchers and institutions responsible for the generation and application of knowledge to address and find solutions to meet the needs of business and society in general.

There is a need to establish a system of research centers where the university is a vital part of ambitious challenges. This change depends on creating the conditions to strengthen faculty research skills. There is also growing awareness by government to make it a priority to invigorate a high-quality community of researchers.

Incentives for private companies to invest and fund research projects through tax exemptions (175%) for resources used to fund research have been established by the government.

Graduate Student Support and Role in Teaching/Research

Most graduate students are supported by company scholarships or with personal funds and loans. A small percentage of scholarships from the government are dedicated to public institutions of higher education. At the PhD level, students participate in specific areas of research. PhD students spend 70% of their time teaching which leaves 30% for courses and research projects. At the Master's (MS) level, it is not customary for candidates to teach. Most Master's programs are not research oriented, leaving minimal time for students to engage in research.

Undergraduate Programs

The average duration of undergraduate programs is five years, but some universities are transitioning to four-year programs that are based on achieving a certain number of credits for completion of the curriculum. The majority of programs use traditional classroom instruction methodologies including lectures focused on theory rather than application. The undergraduate programs run from January to late June and from August to December with a one-week break during each semester. Summer courses are offered with few credits and are not offered in all subjects required for a program.

Due to globalization, most programs require a second language which must be tested before graduation and is not part of the formal curriculum.

Exposure to research at the undergraduate level is not mandatory except for the final semester project.

Internships are provided at the national level and are performed during the last semester of the undergraduate program. Some private universities have exchange programs with other countries, but not all are required to study abroad. More recently, private universities are emphasizing innovation and entrepreneurship, and students are self-motivated to study in these areas.

There is high regional mobility of students to the major cities because of the quality of the regional universities. High demand exists to attend universities in Bogota, Medellin, and Cali and at institutions in Barranquilla, Cartagena or Manizales.

The cost of education is high in private universities ($12 million Colombian pesos per semester) and subsidized in public institutions. Threats of student strikes interrupting the semester increase the risk that students will not complete their studies in the expected five years at public institutions.

Commercialization

Many universities and other organizations are establishing offices of technology commercialization in order to foster entrepreneurship.

There is a growing concern about the lack of commercialization of research from the universities. Yet most universities have been primarily focused on teaching, and not research. University administrators are embracing the need to broaden their focus towards research to build expanded learning experiences to include research and innovation.

The business community has an opportunity to reap the benefits offered by research and innovation by collaborating with universities, yet there remain barriers for direct interaction.

Company/University Partnerships

While university/company partnerships exist, they are generally much less developed than in the US. It is not common for companies to invest in university programs, either for research or student project experiences. Companies do not typically hire PhD-level scientists or engineers, and do not have a clear value-proposition for doing so. PhD graduates are reluctant to return to work in universities because they do not have access to proper laboratories and incentives to work in the university.

Leading universities and companies are beginning to engage in joint projects which improve processes and innovation. This represents an opportunity for growth of the university system and is the reason many universities and other organizations are establishing offices of technology commercialization to foster entrepreneurship.

A cultural shift to realize the advantages of hiring PhD graduates must occur. Many companies do not understand the benefits that scientists can offer in their organizations, and universities have not advocated how graduates add value and impact on the economic sustainability of business.