UNIVERSIDAD DE GRANADA

Facultad de Ciencias Económicas y Empresariales
Departamento de Organización de Empresas
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TESIS DOCTORAL

GESTIÓN DE LA TECNOLOGÍA Y RECURSOS DE CONOCIMIENTO EN EMPRESAS DEL SECTOR TECNOLÓGICO: CONSECUENCIAS Y REQUERIMIENTOS EN UN ÁMBITO DE INNOVACIÓN

MENCIÓN DE DOCTORADO INTERNACIONAL

Tesis doctoral presentada por:
María Teresa Bolívar Ramos

Director
Profesor Dr. Víctor Jesús García Morales

GRANADA, 2014

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Como no sabía que era imposible, lo hice
Albert Einstein

El futuro pertenece a quienes creen en la belleza de sus sueños.
Eleanor Roosevelt.

A mis padres, Juan y María Teresa.

A mi hermano, Juan Diego.

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CAPÍTULO 1

INTRODUCCIÓN

1.1. Introducción al tema de estudio

1.1.1. Introducción

El informe de la Fundación Cotec para la Innovación Tecnológica en España (Cotec, 2013), destacaba recientemente que la competitividad de un país depende de la existencia de un tejido empresarial capacitado para aprovechar las fuentes de conocimiento y tecnología disponibles, con el objeto de poder impulsar el desarrollo de productos y servicios novedosos que tengan aceptación en el mercado global. Estas afirmaciones refuerzan la idea de que, en los últimos tiempos, el conocimiento y los recursos tecnológicos se han convertido en activos estratégicos clave para las organizaciones (Grimpe y Hussinger, 2013; McEvily et al., 2004). Estos recursos juegan un papel esencial en la mejora del desempeño organizativo, y permiten que las empresas sean más innovadoras y aumenten sus fuentes de ventaja competitiva (Huang, 2011; Miller, 2004; Sears y Hoetker, 2014).

Ante la imperante necesidad de reforzar la competitividad empresarial, múltiples empresas están poniendo un énfasis especial en el desarrollo de su estrategia tecnológica, ya que ésta es clave para gestionar los activos basados en la tecnología y el conocimiento (Zahra y Bogner, 2000). Esta estrategia articula los planes de una empresa para poder emplear de forma efectiva sus recursos tecnológicos, de tal manera que se asegure una visión tecnológica y de negocio integrada que conduzca a la mejora de la innovación y del desempeño organizativo (Wilbon, 1999; Zahra, 1996).

Dada la relevancia de esta temática, y el creciente interés que ha suscitado recientemente, distintos estudios han tratado de explicar las consecuencias que pueden derivarse, a nivel organizativo, de la gestión estratégica de los activos basados en la tecnología, en contextos donde innovar supone una necesidad más que una elección. Como requerimientos básicos para llevar a cabo dicha gestión de forma efectiva cabría destacar el apoyo de la alta dirección a la tecnología (Bolívar et al., 2012; Jones y Smith, 1997), y la necesidad de adoptar una orientación tecnológica centrada en estimular los recursos tecnológicos, adoptar nuevas tecnologías para fomentar la renovación de las capacidades organizativas (Yu et al., 2013), y adquirir conocimientos técnicos clave para crear nuevas soluciones orientadas a la innovación y la satisfacción de las necesidades de los clientes (Gatignon y Xuereb, 1997).

Hasta la fecha, investigaciones previas han intentado analizar algunas consecuencias de la gestión de los activos tecnológicos a nivel organizativo, al examinar los efectos en el desarrollo de nuevos recursos, capacidades (ej. innovación, flexibilidad estratégica), y procesos organizativos (ej. emprendimiento corporativo), valorando también el impacto en el desempeño empresarial (Antoncic y Prodan, 2008; García et al., 2013; Zhou y Li, 2010). Sin embargo, muchos de estos trabajos ofrecen un enfoque parcial de este fenómeno, como posteriormente se analizará, y no explican suficientemente cómo diferentes tipos de recursos (tecnológicos) y capacidades contribuyen a la mejora del desempeño organizativo (Gruber et al., 2010; Sheehan y Foss, 2007).

Ante esta situación, el presente trabajo trata de fijar un marco de referencia, tanto teórico como empírico, que permita comprender mejor qué consecuencias pueden producirse, a nivel organizativo, como resultado de la gestión estratégica de recursos tecnológicos y basados en el conocimiento. Para ello, se pondrá un énfasis especial en las repercusiones finales sobre el desempeño organizativo. En líneas globales, se pretende mostrar cómo influye la gestión de la tecnología en la generación de otra serie de recursos, capacidades, y procesos organizativos susceptibles de mejorar el desempeño de las empresas y su capacidad para prosperar. Y, todo ello, teniendo siempre presente que las empresas operan en ámbitos marcados por continuos cambios, en donde potenciar el papel del conocimiento, la tecnología, la innovación, o las actuaciones pioneras en nuevos mercados suponen un plus para mejorar la competitividad y el desempeño empresarial (Berchicci, 2013; Huang, 2011). En este trabajo, con objeto de realizar un análisis más completo, el desempeño organizativo será medido en términos de desempeño estratégico y financiero, y en base a la generación de nuevo conocimiento (patentes). Cabe destacar también que esta investigación se llevará a cabo en empresas del sector tecnológico. Con esto, se pretende dar respuesta a demandas actuales que resaltan la necesidad de profundizar el conocimiento existente sobre la materia objeto de estudio en el contexto de empresas de base tecnológica (Martín et al., 2013).

Una vez acotada la temática central, y para mayor claridad, presentamos las principales preguntas de investigación que se abordarán a lo largo de este trabajo:

- ¿Qué impacto tiene el apoyo de la alta dirección a la tecnología en la generación de habilidades y competencias tecnológicas? ¿Y en el desarrollo de aprendizaje organizativo?
- ¿Cómo influyen las competencias tecnológicas distintivas y el aprendizaje organizativo en el desarrollo de la innovación a nivel empresarial? ¿Son útiles estas competencias y capacidades para mejorar el desempeño financiero?
- ¿Favorece el aprendizaje organizativo la creación de nuevos negocios en empresas de base tecnológica? ¿Se refuerza la tendencia de crear nuevos

negocios cuando las organizaciones no sólo aprenden, sino que también promueven una orientación a la tecnología a nivel corporativo?

- ¿Qué efecto tiene la creación de nuevos negocios en el desempeño financiero?
- ¿Son más propensas a patentar las empresas que más invierten en I+D? ¿Cómo influye la participación en distintas redes de colaboración en la tendencia de las empresas a convertir los resultados de sus actividades de I+D en patentes?

Para dar respuesta a las preguntas planteadas, presentaremos tres capítulos donde abordaremos, de forma más extensiva, los interrogantes señalados.

1.1.2. Delimitación del tema objeto de estudio

Como se adelantaba anteriormente, la presente tesis doctoral gira en torno al análisis de las consecuencias que se derivan a nivel organizativo de la gestión de activos basados en la tecnología y el conocimiento. Especialmente, se valorará su impacto en el desarrollo de recursos, capacidades, y procesos organizativos que pueden favorecer la mejora del desempeño empresarial. Para poder comprender la temática abordada, en primer lugar se delimitarán las ideas centrales sobre las que se estructura este trabajo de investigación.

Estudios previos han mostrado que la gestión de recursos tecnológicos juega un papel fundamental a la hora de mejorar la competitividad y la innovación empresarial (Jones y Smith, 1997; Yu et al., 2013; Zahra y Bogner, 2000). De forma importante, las empresas que potencian los activos tecnológicos se caracterizan tanto por la proactividad a la hora de adquirir, desarrollar o utilizar nuevas tecnologías, que puedan aplicarse en la creación de nuevos productos, como por la habilidad de la compañía para generar y usar conocimientos para ofrecer nuevas soluciones que satisfagan las necesidades del mercado (Gatignon y Xuereb, 1997). En este sentido, Zhou y Li (2010) enfatizan que las empresas que promueven una orientación tecnológica acumulan valiosos flujos de conocimiento a través de la experiencia pasada y procesos tales como importantes inversiones en I+D o la rápida adquisición de nuevas tecnologías, por lo que son más hábiles para explotar sus competencias, mejorar sus tecnologías y productos, y capturar nuevas oportunidades existentes en el entorno.

La gestión estratégica de la tecnología, centrada en promover recursos de tipo tecnológico y basados en el conocimiento, favorece el desarrollo de nuevos productos de forma pionera (Kim et al., 2013). A su vez, potencia la capacidad de la empresa para adquirir experiencia tecnológica sustancial (Gatignon y Xuereb, 1997). Las empresas que gestionan adecuadamente la tecnología no sólo son técnicamente más competentes y flexibles, lo cual facilita el refinamiento de tecnologías actuales para hacer frente a las demandas del mercado (Danneels, 2007), sino que también tienen más habilidad para experimentar nuevas alternativas que mejoren tendencias tecnológicas emergentes, consiguiendo resultados más innovadores (Hortinha et al., 2011).

A la vista de las premisas anteriores, este trabajo parte de que la gestión estratégica de los activos tecnológicos y de conocimiento juega un papel crítico para la generación de nuevos recursos, capacidades, y procesos organizativos con potencial para aumentar el desempeño organizativo de empresas de base tecnológica (García et al., 2013; Wilbon, 1999). Puesto que esta idea es bastante amplia, ya que supone el núcleo común de esta tesis, se hace necesario ser más exhaustivos para detallar el tema objeto de este trabajo. Consecuentemente, tendremos en cuenta cada capítulo de forma particular.

El capítulo 2 realiza un análisis teórico y empírico sobre cómo afecta el apoyo de la alta dirección a la tecnología en la generación de habilidades tecnológicas, competencias tecnológicas, y aprendizaje, y mide también el impacto, directo e indirecto, de todos ellos en la innovación y el desempeño organizativos. Así, el propósito principal de este trabajo consiste no sólo en determinar cómo afecta de forma directa el desarrollo de competencias tecnológicas distintivas y el aprendizaje organizativo en la innovación y el desempeño empresarial, sino también en analizar el papel del apoyo de la alta dirección a la tecnología en el impulso de estas competencias y capacidades críticas para promover la obtención de mejores resultados organizativos.

En el capítulo 3, se hace un estudio para explorar si las organizaciones que aprenden, y adicionalmente promueven una orientación tecnológica, muestran una mayor propensión a crear nuevos negocios que aquéllas que no muestran una orientación a la tecnología a nivel corporativo. A su vez, se investiga cómo influye la creación de nuevos negocios en el desempeño organizativo, con el objeto de aclarar argumentos contradictorios que todavía persisten en esta materia. En otras palabras, en este trabajo se pretende esclarecer si aquellas empresas de base tecnológica caracterizadas por desarrollar más conocimiento y que apoyan el desarrollo tecnológico, tienden a crecer más (a través de la creación de nuevos negocios), y a obtener mejores rendimientos, que las que no desarrollan una estrategia de orientación tecnológica.

El capítulo 4 se centra en dos de los recursos tecnológicos cuya gestión es particularmente relevante: las inversiones en I+D y las patentes. Esta investigación analiza si las empresas que participan en redes de colaboración nacionales, regionales, o más internacionales, muestran una mayor propensión a patentar los resultados de sus actividades de I+D que aquellas compañías que no participan en estas colaboraciones. La importancia de medir el desempeño de esta forma radica en que recursos intangibles, como las patentes, sirven para ofrecer a las empresas ventajas competitivas sostenibles

(Hsu y Ziedonis, 2013), al proteger el conocimiento valioso que sustenta dicha ventaja competitiva (Pérez-Luño y Valle-Cabrera, 2011).

Finalmente, y antes de concluir este epígrafe, es necesario explicar a qué nos referimos cuando hablamos de empresas del sector tecnológico, ya que constituyen la unidad de análisis de la presente tesis doctoral.

Las empresas de base tecnológica son aquéllas que se caracterizan por enfatizar las inversiones en I+D, la innovación y el emprendimiento, y juegan un papel determinante en el crecimiento, la productividad, la creación de nuevas industrias y nuevos productos y procesos (Grinstein y Goldman, 2006).

La OECD, Eurostat (Comisión Europea), y el Instituto Nacional de Estadística español han clasificado, de forma más específica, a las empresas de base tecnológica. Eurostat ha indicado que atendiendo al enfoque sectorial, que agrupa a las industrias manufactureras según su intensidad tecnológica (inversión en I+D/ valor añadido), y utilizando la nomenclatura estadística de actividades económicas en la Comunidad Europea (NACE), pueden distinguirse industrias de alta, media-alta, media-baja, o baja tecnología.

Por otro lado, en lo referente a sectores de servicios, estas empresas han sido categorizadas atendiendo al criterio de "servicios basados en conocimiento", establecidos por Eurostat en 2011, definidos también en base a códigos de la "NACE rev.2". De esta forma, los sectores de servicios han sido agrupados según su nivel de intensidad de conocimiento, dando lugar a cuatro categorías: servicios de alta tecnología intensivos en conocimiento, servicios de mercado intensivos en conocimiento; otros servicios intensivos de conocimiento; y servicios menos intensivos en conocimiento (Marzocchi y Gagliardi, 2013).

La tabla 1.1. muestra la clasificación de las industrias manufactureras y de servicios, de base tecnológica, según la nomenclatura NACE y la categorización de Eurostat anteriormente señalada.

Tabla 1.1. Clasificación de industrias manufactureras y de servicios de base tecnológica

Industrias manufactureras

Industrias de Alta Tecnología	Industrias de Media-alta Tecnología	Industrias de Media-baja Tecnología	Industrias de Baja Tecnología
▪ Fabricación de productos farmacéuticos (21) ▪ Fabricación de productos informáticos, electrónicos, y ópticos (26) ▪ Construcción aeronáutica y espacial y su maquinaria (30.3)	▪ Industria química (20) ▪ Fabricación de armas y municiones (25.4) ▪ Fabricación de material y equipo eléctrico; fabricación de maquinaria y equipo n.c.o.p.; Fabricación de vehículos de motor, remolques y semirremolques (27-29) ▪ Fabricación de otro material de transporte excepto: construcción naval, construcción aeronáutica y espacial y su maquinaria (30 excepto 30.1, 30.3) ▪ Fabricación de instrumentos y suministros médicos y odontológicos (32.5)	▪ Reproducción medios comunicación grabados (18.2) ▪ Fabricación de coque y productos refinados de petróleo (19) ▪ Fabricación de caucho y productos de plástico, productos minerales no metálicos, metales básicos (22-24) ▪ Fabricación de productos de metal, excluyendo maquinaria y equipos (25, excepto 25.4) ▪ Construcción de buques y embarcaciones (30.1) ▪ Reparación e instalación de maquinaria y equipos (33)	▪ Manufactura de productos alimenticios, bebidas, tabaco, textiles y vestimenta, productos de cuero, madera, y papel (10-17) ▪ Impresión y reproducción de medios de comunicación grabados (18 excepto 18.2) ▪ Fabricación de muebles (31) ▪ Otras manufacturas, excluyendo instrumentos médicos y dentales (32)

Sectores de servicios

Servicios de Alta Tecnología intensivos en conocimiento	Servicios de mercado intensivos en conocimiento	Otros servicios intensivos en conocimiento	Servicios menos intensivos en concimiento
▪ Proyectos cinematográficos, de video, y producción de programas de televisión, grabación de sonido y edición musical (59) ▪ Servicios de programación y emisión (60) ▪ Telecomunicaciones (61) ▪ Programación, consultoría y otras actividades informáticas (62) ▪ Servicios de información (63) ▪ Investigación y desarrollo científico (72)	▪ Transporte de aguas (50) ▪ Transporte aéreo (51) ▪ Actividades legales y de contabilidad (69) ▪ Actividades de sedes centrales, y de consultoría (70) ▪ Actividades de arquitectura e ingeniería, análisis y estudios técnicos (71) ▪ Publicidad e investigación de mercados (73) ▪ Otros servicios profesionales y científicos (74) ▪ Actividades de empleo (78) ▪ Actividades de seguridad e investigación (80)	• Actividades de publicación (58) • Actividades veterinarias (75)	▪ Venta al por mayor y por menor, y reparación de vehículos de motor y motocicletas (45) ▪ Comercio al por mayor y por menor excepto de vehículos de motor y motocicletas (46, 47) ▪ Transporte terrestre y por tuberías (49) ▪ Almacenamiento y actividades de apoyo para el transporte (52) ▪ Alojamiento (55) ▪ Actividades de servicios de comida y bebida (56) ▪ Actividades inmobiliarias (68) ▪ Actividades de alquiler (77) ▪ Agencias de viajes, reservas de tour-operadores (79) ▪ Administrativos de oficina (82) ▪ Servicios de embellecimiento de edificios (81) ▪ Servicios postales y de mensajería (53)

Fuente: Elaboración propia, Eurostat (2013), Marzocchi y Gagliardi (2013)

A modo de aclaración, ha de indicarse que pese a que esta es la clasificación vigente de empresas de base tecnológica, la misma ha sufrido algunas modificaciones en tiempos recientes. Así, y sirva de ejemplo, hace sólo unos pocos años Eurostat y la OECD consideraban, de acuerdo con los códigos "NACE rev 1.1.", que las empresas industriales de alta tecnología estaban integradas por la fabricación aeronáutica y espacial; farmacéutica; maquinaria de oficina, contabilidad e informática; equipos y aparatos de radio, televisión, y comunicaciones; e instrumentos médicos, ópticos, y de precisión.

En la presente tesis, el capítulo 2 se centra en el análisis de empresas de alta tecnología españolas, tanto manufactureras como de servicios. El capítulo 3, por su parte, sigue la misma línea, pero esta vez selecciona empresas de alta tecnología europeas. Finalmente, el capítulo 4 analiza empíricamente una muestra de empresas de base tecnológica españolas, pertenecientes a industrias manufactureras de alta, media-alta, media-baja, y baja tecnología, así como de sectores de servicio intensivos en conocimiento.

Una vez concluida la delimitación del objeto de estudio, se hace preciso clarificar en qué consisten, y cómo podrían definirse, los principales conceptos que aparecen en este trabajo de investigación. A ellos se dedicará el siguiente apartado.

1.1.3. Principales conceptos utilizados en la investigación

El punto de partida de este trabajo radica en la gestión de la tecnología (*technology management),* cuyos activos están asociados al conocimiento. Aunque la gestión de la tecnología puede definirse de diversas formas, en este estudio seguiremos la conceptualización realizada por Paramanathan et al. (2004) que, a su vez, está basada en la propuesta realizada por el Instituto Europeo de Tecnología y Gestión de la Innovación. Según la definición dada por estos autores, la gestión de la tecnología alude a la efectiva identificación, selección, adquisición, desarrollo y explotación de las tecnologías que son necesarias para alcanzar y mantener posiciones competitivas en el mercado y un desempeño empresarial acorde con los objetivos organizativos. Teniendo en cuenta dichas premisas, en esta tesis abordaremos cómo la gestión de la tecnología -centrada en impulsar estratégicamente determinados activos tecnológicos (que posteriormente analizaremos), y basados en el conocimiento (Jones y Smith, 1997)- puede afectar al desarrollo de nuevos recursos y capacidades organizativas susceptibles de incrementar el desempeño organizativo.

La cuestión relativa a definir el conocimiento ha dado lugar a muchos debates epistemológicos desde la clásica Grecia hasta la actual filosofía occidental. Por tanto, se trata de un concepto que, pese a haber sido definido en diversas ocasiones, no genera un claro consenso (Alavi y Leidner, 2001). Una definición común de conocimiento viene a considerarlo como una creencia verdadera justificada (Huber, 1991; Nonaka y Takeuchi, 1995), la cual puede "aumentar la capacidad de una entidad para actuar de forma efectiva" (Sabherwal y Becerra-Fernández, 2003, p.227). Otras definiciones de conocimiento, más amplias, señalan que es un flujo en el que se mezclan la experiencia, valores importantes, información contextual y puntos de vista de expertos, que facilitan un marco de análisis para la evaluación e incorporación de nuevas experiencias e información. En las organizaciones, a menudo, se encuentra no sólo en los documentos, sino también en las rutinas organizativas, procesos, prácticas y normas (Davenport y Prusak, 1998). En consecuencia, ya sea explícito o tácito (Li et al., 2010; Nonaka y Takeuchi, 1995), y pese a que el conocimiento se puede contemplar desde diversas perspectivas, lo que queda claro es que se trata de un recurso intangible crítico, capaz de añadir valor a las organizaciones (Grant, 1996a; Li et al., 2010; McEvily et al., 2004; Nag y Gioia, 2012).

Cuando hablamos de tecnología, nos referimos al "conjunto de conocimientos teóricos y prácticos, *know-how,* habilidades y dispositivos que son empleados por las empresas para desarrollar, producir y repartir sus productos o servicios […], y puede estar incrustado en personas, materiales, instalaciones, procedimientos y procesos físicos" (Antoncic y Prodan, 2008, p. 258; Burgelman y Rosenbloom, 1997, p.273). Por su parte, los recursos tecnológicos son todos aquellos activos usados para desarrollar nuevos productos y generar procesos innovadores (Tseng et al., 2007). Estos recursos no sólo anteceden la generación de rentas, resultados de investigación, o innovaciones, sino que también influyen en el alcance de las operaciones de una empresa y en muchos resultados importantes a nivel organizativo (Ndofor et al., 2011).

La cartera de activos tecnológicos que puede gestionar una compañía puede ser bastante amplia, ya que englobaría la maquinaria, herramientas, equipo, conocimiento y habilidades que posee o controla una empresa (Zahra y Kirchoff, 2005). Entre estos recursos tecnológicos se encuentran los equipos de una empresa (o infraestructura tecnológica), sus inversiones en I+D, patentes, la reputación por excelencia tecnológica, o los ingenieros con las apropiadas habilidades tecnológicas, entre otros (Zahra et al., 2003; Zahra y Kirchoff, 2005). El capítulo 2, al hablar de activos tecnológicos, se centra específicamente en el apoyo de la alta dirección a la tecnología (recurso humano asociado al éxito tecnológico), las habilidades tecnológicas, y las competencias tecnológicas distintivas, dado que merecen una especial atención por su trascendencia a la hora de promover ventajas competitivas asociadas a la tecnología (Bolívar et al., 2012; Huang, 2011; Leonard-Barton, 1992; Newbert et al., 2007; Walsh y Linton, 2002), y son cruciales para el desarrollo de nuevo conocimiento, la creación de nuevos productos y servicios, la explotación de nuevas oportunidades, y la mejora del desempeño empresarial (Martín et al., 2013). Veamos, a continuación, en qué consiste cada uno de ellos.

El papel estratégico de la alta dirección -"*CEOs* y sus subordinados directos responsables de la política corporativa" (Green, 1995, p. 223)- incluye la ratificación de las intenciones estratégicas, la evaluación y aprobación de nuevas iniciativas provenientes de niveles organizativos más bajos, y la coordinación de recursos estratégicos (Kor y Mesko, 2013; Shimizu, 2012). La alta dirección necesita identificar nuevas oportunidades de crecimiento y los procesos apropiados para desarrollar dichas oportunidades. De ahí que, identificar el papel que desempeña la tecnología, así como promover el apoyo necesario a la misma, es un cometido clave que ha de desempeñar la alta dirección, pues son precisamente las percepciones positivas en relación a la utilidad de la tecnología las que resultan en acciones específicas por parte de la dirección para aprovechar y asimilar dicho recurso estratégico (García et al., 2013; Jones y Smith, 1997; Liang et al., 2007).

El apoyo de la alta dirección a la tecnología puede manifestarse a través de acciones como la dotación de recursos para promover el desarrollo tecnológico, la creación de un clima que fomente la tecnología (Premkumar y Roberts, 1999), o el impulso de programas de formación técnica para los empleados (Anderson et al., 2001). Todas estas funciones son críticas al ofrecer una gran cantidad de beneficios potenciales relativos al desarrollo de habilidades, competencias y capacidades tecnológicas, que constituyen recursos que mejoran el desempeño organizativo (García et al., 2013). En el contexto del capítulo 2, las habilidades tecnológicas hacen referencia a técnicas y conocimientos científicos específicos (Leonard-Barton, 1992), relativos a la habilidad para implementar y usar nuevas tecnologías. Por otro lado, las competencias tecnológicas distintivas suponen "la pericia de la organización para movilizar varios recursos científicos y tecnológicos a través de una serie de rutinas y procedimientos, los cuales permiten el desarrollo y diseño de nuevos productos y procesos" (Real et al., 2006, p. 508).

Es preciso aclarar que, aunque en este estudio se habla de "competencias tecnológicas" (Danneels, 2007; Huang, 2011; Linton y Walsh, 2013; Real et al., 2006), siguiendo literatura previa, otros muchos autores hablan de "capacidades tecnológicas" (Kotha et al., 2011; Lee et al., 2001; Sears y Hoetker, 2014). En vista de los objetivos de esta investigación, se ha optado por la primera terminología siguiendo la argumentación de Marino (1996; p. 41), según el cual: "los competencias tienen un componente tecnológico o basado en el conocimiento. En particular, las competencias normalmente resultan de una mezcla de tecnología y habilidades de producción. Las capacidades, por otro lado, están más enraizadas en procesos y rutinas de negocio".

Potenciar tanto el apoyo de la alta dirección a la tecnología como las habilidades y recursos tecnológicos puede afectar la generación de importantes capacidades, como son el aprendizaje y la innovación a nivel organizativo (Bolívar et al., 2012; Linton y Walsh, 2013). El aprendizaje organizativo puede definirse como la adquisición y el desarrollo del nuevo conocimiento, por parte de una empresa, que facilita cambios beneficiosos (Argote, 2012; Huber, 1991), y su reto principal radica en realizar un balance entre asimilar nuevo conocimiento (explorar) y usar lo que ya se ha aprendido (explotar) (March, 1991; Vera y Crossan, 2004). Dada su trascendencia, diversas investigaciones sugieren que el aprendizaje organizativo es crucial para que las empresas innoven, se ajusten al entorno, puedan apropiarse de oportunidades emergentes en el mercado, y creen ventajas competitivas (Bingham y Davis, 2012; Zahra, 2012). Generalmente, el aprendizaje surge cuando las organizaciones necesitan adaptarse y ofrecer nuevas soluciones ante condiciones cambiantes del entorno (Wagner et al., 2013). Por este motivo, también, la generación de aprendizaje y el desarrollo del nuevo conocimiento suelen estar vinculados con el fomento de la innovación organizativa (Hagedoorn y Wang, 2012; Hull y Covin, 2010; Smith et al., 2005).

La palabra innovación proviene del término latino "innovare", el cual hace referencia a la alteración de algo introduciendo novedades. Partiendo de la concepción inicial dada por Schumpeter (1934), cuando hablamos de innovación nos referimos a la adopción de una idea o comportamiento, ya sea un sistema, política, programa, dispositivo, proceso, producto o servicio, que es nuevo para la organización que lo adopta (Daft, 1982; Damanpour et al., 2009). Estas ideas podrían enlazarse con el concepto que ofrece Porter (1990, p.780), según el cual la innovación es "una nueva manera de hacer las cosas que se *comercializa*", lo cual se traduce en que la innovación consiste en invención más comercialización. Aunque la literatura ha distinguido múltiples tipologías de innovación -más de veinte, en algunos casos- las más conocidas son probablemente las que distinguen entre : 1) innovaciones radicales (que introducen cambios fundamentales y sustanciales) o incrementales (sólo simples variaciones); 2) innovaciones de producto (productos o servicios nuevos en el mercado) o de proceso (basados en nuevos métodos de producción, estilos de gestión, o nuevas tecnologías); y 3) la que clasifica las innovaciones como tecnológicas (o técnicas, que darían lugar a productos, procesos y tecnologías para producir/prestar los productos y servicios relacionados con la actividad principal de la organización) y administrativas (más relacionadas con aspectos de gestión) (Crossan y Apaydin; 2010; Damanpour et al., 2009).

En cualquiera de sus vertientes, estudios previos han destacado que la innovación es un requerimiento básico para que las empresas puedan penetrar nuevos mercados, establecer nuevas tecnologías, y adaptarse y cambiar para hacer frente a las demandas de sus clientes (Jiménez y Sanz, 2011; Smith et al., 2005). Por este motivo, en pleno siglo XXI, la innovación ha de concebirse como un instrumento básico de toda empresa para mejorar el tipo de ventaja competitiva y el desempeño organizativo (Crossan y Apaydin; 2010; Thornhill, 2006).

Para valorar, precisamente, los efectos en el desempaño de las variables estratégicas anteriores, el capítulo 2 incluye el concepto de desempeño organizativo, el cual engloba el desempeño estratégico (cuota de mercado y tasa de crecimiento de ventas) y el desempeño financiero (rentabilidad económica, rentabilidad financiera, y rentabilidad de las ventas) (Murray y Kotabe, 1999). De esta forma, se capturan tanto las dimensiones estratégicas como financiera que normalmente constituyen el objetivo central al medir el desempeño de una empresa (Murray y Kotabe, 1999; Roth y Morrison, 1990). Esta concepción de desempeño organizativo será también la que se utilice en el tercer capítulo.

En el capítulo 3, los conceptos básicos que se tratan son el aprendizaje organizativo, la orientación tecnológica, la creación de nuevos negocios, y el desempeño organizativo. Puesto que estos conceptos ya han sido anteriormente descritos, excepto la creación de nuevos negocios y la orientación a la tecnología, pasaremos a especificar en este punto en qué consisten los mismos.

La creación de nuevos negocios constituye una de las dimensiones del emprendimiento corporativo (Narayanan et al., 2009), y se refiere a todas las actividades, procesos y prácticas que se centran en el desarrollo de nuevos negocios en campos, mercados, o industrias nuevas o existentes, ya sea por medios internos o externos (Covin y Miles, 2007; Narayanan et al., 2009; Sharma y Chrisman, 1999). Estas actividades fomentan el establecimiento de la innovación como parte de la cultura corporativa, promueven la detección de oportunidades de forma pionera, y el desarrollo de nuevos productos, servicios y mercados (Block y MacMillan, 1993). De ahí que la importancia de la creación de nuevos negocios radique en su contribución al éxito, beneficio, y crecimiento de las empresas establecidas (Burgelman y Valikangas, 2005; Zahra et al., 2006).

Una de las cuestiones clave que muestran estudios recientes consiste en explorar si las empresas promueven acciones de emprendimiento corporativo cuando fomentan el aprendizaje y desarrollan una orientación tecnológica (Martín et al., 2013), la cual consiste en la adquisición de una base tecnológica sustancial para desarrollar nuevos productos (Yu et al., 2013). El capítulo tercero se dedicará a explorar la cuestión planteada basándose, específicamente, en la dimensión de creación de nuevos negocios. También se analizarán los efectos derivados en el desempeño organizativo, conceptualizado en los mismos términos que en el capítulo 2.

Finalmente, el capítulo 4 se centra en dos de los recursos tecnológicos que más interés suscitan dentro de la gestión estratégica de la tecnología y el conocimiento en la empresa: las inversiones en I+D y las patentes (Nicholls-Nixon y Woo, 2003; Pérez-Luño y Valle-Cabrera, 2011; Somaya et al., 2007; Zahra y Bogner, 2000).

Las inversiones en I+D persiguen la consecución de ventajas competitivas y la creación de valor en la empresa (Mudambi y Swift, 2013). Su fin principal consiste en desarrollar nuevo conocimiento, y potenciar la capacidad inventiva de la empresa (Hagedoorn y Wang, 2012; Nicholls-Nixon y Woo, 2003). A través de la I+D las organizaciones promueven la renovación estratégica (Knott y Posen, 2009), lo cual es clave para generar innovaciones, crear nuevos productos o servicios, y alcanzar beneficios (Penner-Hahn y Shaver, 2005).

Si bien es cierto que existen múltiples mecanismos a través de los cuales la empresa puede proteger las ganancias que se derivan de sus inversiones en I+D, las patentes son unas de las más conocidas (Somaya, 2012; Zahra, 1996). Las patentes son una forma de derechos de propiedad intelectual que preservan los resultados de la I+D frente a potenciales imitadores, y aseguran la apropiación de los beneficios derivados de inversiones en I+D (Shane, 2001). Además, constituyen un activo estratégico que puede ser utilizado por las empresas en negociaciones tecnológicas con potenciales colaboradores, para generar ganancias a través de acuerdos de licencia, atraer capital, acceder a mercados internacionales, disfrutar de monopolio temporal, o incrementar la reputación de la compañía, entre otros usos estratégicos (Blind et al., 2006; González y Nieto, 2007).

La literatura previa especializada indica que cuanto mayor sean las inversiones en I+D, mayor suele ser la propensión a patentar de una empresa, si bien no son el único factor que puede condicionar la tendencia a patentar (Pérez-Luño y Valle-Cabrera, 2011). En este sentido, el capítulo 4 introduce el concepto de redes de colaboración, definidas como enlaces con otros agentes o instituciones para compartir o comprar conocimiento y tecnología (Ahuja, 2000; Trigo y Vence, 2012). Como Van Burg et al.

(2013) señalan, estas conexiones permiten que las empresas puedan acceder a recursos y conocimientos complementarios. Tanto las colaboraciones verticales (compradores y proveedores), como horizontales (competidores u otros socios), pueden ser valiosas: los clientes pueden ser útiles para definir las necesidades del mercado, los proveedores facilitan el acceso a largo plazo a los activos especializados y complementarios, y los competidores ayudan el aprendizaje de nuevas habilidades, el acceso a los bienes necesarios, y la solución de problemas comunes. Por supuesto, otros colaboradores, como instituciones de investigación públicas o privadas, laboratorios, o universidades, son también críticos, puesto que llevar a cabo actividades de I+D conjuntas favorece que la empresa pueda utilizar recursos externos de forma directa y sistemática (Nieto y Santamaría, 2007), lo cual puede repercutir en sus actividades inventivas e innovadoras.

La pertenencia a diferentes redes de colaboración puede influir de distintas formas en la tendencia de una empresa a patentar las invenciones resultantes de su I+D. A priori, la colaboración, con socios tales como universidades, proveedores, clientes, centros privados de I+D, o incluso competidores, constituye una fuente de conocimiento potencialmente valioso (Noseleit y de Faria, 2013). Sin embargo, ese conocimiento está impregnado por las características del lugar donde procede. Por este motivo, en el cuarto capítulo se distinguen redes de colaboración de tipo nacional, regional, e internacional, con el objeto de ofrecer un análisis más preciso sobre su impacto en la propensión a patentar de la empresa. Consecuentemente, y a diferencia de los capítulos 2 y 3, el desempeño en este caso se medirá en términos de patentes, ya que supone una medida indicativa de la habilidad de una empresa para generar conocimiento potencialmente valioso (McCann y Folta, 2011; Rothaermel y Thursby, 2007). Se ofrece, así, un análisis más completo sobre cómo influyen acciones estratégicas relacionadas con la gestión de la tecnología en el desempeño organizativo.

1.1.4. Interés de la investigación

El informe del *World Economic Forum* sobre competitividad global 2012-2013 resaltaba recientemente la siguiente idea: "En el mundo globalizado actual, la tecnología es cada vez más esencial para que las empresas puedan competir y prosperar" (World Economic Forum, 2012, p.6). Esta afirmación resume la esencia, o hilo conductor, del presente trabajo de investigación, que trata de explicar las consecuencias, y potenciales beneficios, que pueden derivarse de la gestión de los recursos tecnológicos y basados en el conocimiento en las empresas de base tecnológica. Se pretende, así, dar respuesta a demandas actuales que llaman la atención sobre la necesidad de elaborar estudios encaminados a comprender cómo las empresas pueden mejorar sus capacidades (ej. innovación) y desempeño (ej. financiero, en términos de creación de nuevo conocimiento), a través del fomento de dichos recursos estratégicos a nivel organizativo (García et al., 2013; Real et al., 2006).

Dada su trascendencia, la conexión entre la gestión de los activos tecnológicos (llevada a cabo a través de la estrategia tecnológica) y el desempeño organizativo, medido de formas diversas, ha sido investigada desde hace algunas décadas. A finales de los años 80 del siglo pasado, Miller (1988) hacía notar que pese a la existencia de distintos trabajos que parecían vincular la tecnología con el desempeño en la empresa, todavía existía gran incertidumbre en esta materia, al no haber un enfoque que permitiese comprender de forma integral esta relación.

Posteriormente, y con objeto de intentar cubrir esas lagunas, se han desarrollado múltiples estudios en este campo (Real et al., 2006; Wilbon, 1999; Zahra, 1996). Entre los más citados, cabe destacar el de Zahra y Bogner (2000), quienes analizaron empíricamente la relación entre la gestión estratégica de diversos recursos tecnológicos y fundados en el conocimiento (tales como I+D, uso de tecnología externa, patentes, etc.) y el desempeño organizativo, teniendo en cuenta el efecto moderador del entorno, dado su potencial impacto significativo en la intensidad de la relación entre la estrategia tecnológica y el desempeño. Algo más tarde, en la misma línea, Song et al. (2005) investigaron la relación entre las capacidades tecnológicas de una empresa y su implicación en el desempeño, en términos de ingresos, ventas, y rentabilidad financiera, en contextos de alta y baja turbulencia tecnológica. De forma más reciente, Carnabuci y Operti (2013) han destacado que la habilidad de la empresa para recombinar estratégicamente tecnologías existentes es clave para fomentar las ganancias generadas, y el desempeño innovador de una empresa. Por otro lado, García et al. (2013) han mostrado que el apoyo de la alta dirección a la tecnología impulsa la generación de competencias tecnológicas distintivas, y aumenta la capacidad de absorción de conocimiento, lo que promueve el desarrollo del emprendimiento corporativo y la mejora del desempeño estratégico y financiero de la empresa.

Muchos de los trabajos elaborados en este campo han realizado importantes contribuciones en el marco de la teoría de recursos y capacidades (Barney, 1991; Peteraf, 1993; Wernerfelt, 1984), al poner de manifiesto que los recursos basados en el conocimiento y la tecnología constituyen la principal fuente de ventaja competitiva de una empresa, y contribuyen a la mejora del desempeño empresarial (Bolívar et al., 2012; Song et al., 2005; Zahra y Bogner, 2000). Siguiendo a Barney (1991), cabe recordar que, según este enfoque: 1) las empresas se diferencian por los recursos que poseen y las capacidades que desarrollan a través de su combinación (heterogeneidad); y 2) estos recursos y capacidades no están disponibles para todas las empresas en las mismas condiciones (movilidad imperfecta). A modo aclaratorio, cuando se habla de "recursos", quedarían incluidos todos los activos, capacidades, procesos organizativos, características de la empresa, información, conocimiento, etc., que son controlados por ella y que le permiten concebir y desarrollar estrategias para aumentar su eficacia y eficiencia (Barney, 1991). Por tanto, las empresas sustentan su ventaja competitiva en recursos valiosos, raros, inimitables, y no sustituibles que poseen, y de cuya interacción emergen capacidades superiores (Eisenhardt y Martin, 2000; Gruber et al., 2010). No en vano: "exactamente los mismos recursos que se utilizan... en combinación con diferentes tipos y cantidades de otros recursos ofrecen un servicio diferente" (Penrose, 1959; p. 25).

Este enfoque de recursos y capacidades se complementa en este trabajo por una de sus variantes: el enfoque de la empresa basado en el conocimiento, el cual enfatiza la idea de que el concepto de recurso incluye activos intangibles basados en el conocimiento (Grant, 1996a; Kogut y Zander, 1992). De forma notable, esta perspectiva señala que la ventaja competitiva de una empresa reside en su capacidad para crear, almacenar y aplicar el conocimiento (Nonaka y Takeuchi, 1995; Spender, 1996). Los activos basados en el conocimiento son frecuentemente difíciles de imitar y socialmente complejos y, por ello, son útiles para producir ventajas competitivas sostenibles en el tiempo (Grant, 1996a; Zahra y George, 2002).

Los marcos teóricos presentados inspiran esta tesis, la cual, a su vez, realiza importantes contribuciones a los mismos. Como se ha comentado, en las empresas más exitosas, la gestión estratégica de los activos tecnológicos y basados en el conocimiento suponen el punto central de su estrategia corporativa, ya que decisiones alejadas del fomento de la tecnología pueden afectar de manera importante a la supervivencia y el desempeño organizativo (Wilbon, 1999). Sin embargo, como diversos autores recientemente han señalado: "la teoría actual no es suficientemente clara en cómo diferentes tipos de recursos y capacidades contribuyeron al desempeño, ni clarifica cómo las empresas pueden combinar diferentes recursos y capacidades para alcanzar resultados superiores en su desempeño" (Gruber et al., 2010, p.1338). Por este motivo, en el trabajo de investigación aquí presentado, intentamos superar estas limitaciones de la teoría de recursos y capacidades (Gruber et al., 2013; Priem y Butler, 2001; Sheehan y Foss, 2007). De forma específica, en el capítulo 2 se analiza: 1) El papel determinante y estratégico del apoyo de la alta dirección a la tecnología, como requerimiento para promover el desarrollo de recursos y capacidades asociadas a la tecnología; y 2) las sinergias derivadas de la combinación de conocimiento, generado en procesos de aprendizaje, y activos tecnológicos (habilidades tecnológicas, competencias tecnológicas distintivas), como motores complementarios impulsores de la innovación organizativa. Adicionalmente, se valora cómo afectan los recursos y capacidades anteriores al desempeño organizativo, medido en términos de desempeño estratégico y financiero. El marco teórico propuesto en este estudio, por tanto, extiende su contribución también a la teoría de capacidades dinámicas, al explicar cómo integran las empresas sus recursos y competencias en capacidades (en este caso, aprendizaje, innovación) para hacer frente a entornos sometidos a continuos cambios (Eisenhardt y Martin, 2000; Teece et al., 1997). Cabe señalar que las capacidades dinámicas son el antecedente de rutinas organizativas y estratégicas a través de las cuales los gerentes alteran su base de recursos, los integran, y recombinan, con objeto de generar nuevas estrategias creadoras de valor y nuevas fuentes de ventaja competitiva (Eisenhardt y Martin, 2000; Teece et al., 1997; Zahra et al., 2006; Zhou y Li, 2010)

Por otro lado, en el capítulo 3 se pretende, nuevamente, esclarecer si existe ese efecto complementario entre el aprendizaje organizativo y la tecnología (derivada de la orientación tecnológica) como fuentes de ventaja competitiva (Barney, 1991; Martín et al., 2013). En este sentido, se trata de contrastar argumentos contrapuestos existentes en relación a cómo afectan a la voluntad para crear de nuevos negocios, expendiendo las líneas actuales. Por un lado, la creación de nuevos negocios, como proyecto emprendedor, representa procesos de aprendizaje que necesitan de la contribución de varios recursos complementarios, como el conocimiento y la tecnología (Ravasi y Turati, 2005). Por este motivo, sería lógico pensar que si la empresa aprende y favorece una orientación tecnológica corporativa, que promueva la gestión estratégica de la tecnología, su tendencia a crear nuevos negocios será mayor. Sin embargo, el desarrollo de la orientación tecnológica no es una tarea simple, y en ocasiones se suceden problemas para integrar el conocimiento existente con las nuevas tecnologías, lo que potencialmente podría mermar la creación de nuevos negocios (Covin y Miles, 2007). A su vez, se valora si estas actividades emprendedoras mejoran el desempeño estratégico y financiero de la empresa, o no, puesto que, aunque son críticas para favorecer la renovación estratégica y la creación de riqueza en la empresa, también implican costes elevados a nivel organizativo (Zahra et al., 2006).

El capítulo 4, finalmente, avanza la literatura sobre estrategia tecnológica, aportando evidencia teórica y empírica de cómo influyen las redes de colaboración nacionales, regionales, y más internacionales en la propensión de la empresa a patentar los resultados de sus actividades en I+D. En el plano teórico, destaca su contribución al enfoque de la empresa basada en el conocimiento (Grant, 1996a; Nonaka y Takeuchi, 1995; Spender, 1996). De manera importante, se analiza cómo las distintas combinaciones resultantes de la I+D de la empresa con el conocimiento y la tecnología adquirida a través de distintas redes de colaboración pueden afectar la creación de ventaja competitiva. Precisamente, para preservar dichas ventajas, obtenidas por la posesión de conocimiento valioso, muchas empresas actualmente optan por usar mecanismos de apropiación tales como las patentes (Teece, 1986). Nuevamente, en este capítulo, se valoran acciones estratégicas basadas en la gestión de la tecnología con importantes repercusiones para la organización.

Para completar los argumentos que justifican el interés de este trabajo de investigación, es necesario hacer referencia a la ***metodología*** empleada a lo largo del mismo.

En primer lugar, el capítulo 2 realiza un estudio empírico basado en las empresas españolas de alta tecnología, tanto industriales como de servicios. Estas organizaciones se han elegido porque no sólo enfatizan, de forma estratégica, la innovación, los activos tecnológicos como inversiones en I+D, o un alto porcentaje de científicos e ingenieros empleados, sino que también compiten en mercados globales y con cortos ciclos de vida del producto (Collins y Smith, 2006). Estos hechos avalan la importancia de desarrollar una cultura corporativa basada en la tecnología. Por otro lado, la elección del ámbito geográfico español surge de la necesidad de realizar estudios que investiguen la influencia de las variables estratégicas tecnológicas a nivel organizativo en este país (Pérez-Luño y Valle-Cabrera, 2011).

Los datos de las empresas analizadas se obtuvieron de la base de datos Bradstreet (2003). Inicialmente, se desarrolló y envió un cuestionario que fue respondido por los directivos o "CEOs" de las compañías, los cuales reciben una gran cantidad de información de los distintos departamentos que componen la organización y, por tanto, son una valiosa fuente para evaluar distintas variables organizativas. De las 1000 empresas aleatoriamente seleccionadas, y a las que se les envió el cuestionario, finalmente sólo 201 fueron incluidas en la investigación. Posteriormente, los datos fueron analizados a través de un modelo de ecuaciones estructurales, utilizando el programa LISREL 8.3. Este programa es útil para llevar a cabo el análisis propuesto, ya que permite transformar constructos teóricos en modelos matemáticos, con el objeto de estimar y evaluar empíricamente estos últimos.

En el capítulo 3 se vuelven a analizar empresas de alta tecnología, obtenidas de la base de datos Amadeus (2007), si bien esta vez se amplía el ámbito geográfico a empresas europeas. Para proceder con este estudio empírico se diseñó un cuestionario que fue enviado a 1000 empresas de base tecnológica de diez países pertenecientes a la Unión Europea (Alemania, Austria, Bélgica, Dinamarca, España, Francia, Italia, Países Bajos, Polonia, y Reino Unido). Tras ser respondido por los directores ejecutivos, finalmente se obtuvo una muestra válida de 160 empresas. Para testar el efecto moderador de la orientación tecnológica en la relación entre el aprendizaje organizativo y la creación de nuevos negocios, se utilizó una regresión jerárquica moderadora. Asimismo, para comprobar cómo influye la creación de nuevos negocios en el desempeño organizativo se realizó una regresión lineal jerárquica, ya que es un método adecuado para probar la relación entre las variables estudiadas, y que permite también valorar la ausencia de multicolinealidad. En ambos casos, se utilizó el programa estadístico SPSS Statistics 20.

En el capítulo 4, se trabajó con una muestra de empresas españolas de base tecnológica, pertenecientes a los sectores de alta, media-alta, media-baja, y baja tecnología. La principal razón para seleccionar este tipo de empresas tiene que ver con la necesidad de contar con empresas que suelan invertir en I+D, estén comprometidas con la creación de invenciones e innovaciones, y en consecuencia probablemente tiendan a patentar (Pérez-Luño y Valle-Cabrera, 2011). Para tener acceso a los datos de estas compañías, se utilizó la base de datos PITEC ("Panel de Innovación

Tecnológica"), que ofrece información sobre múltiples recursos tecnológicos de empresas españolas, tales como inversión en I+D o patentes, así como sobre redes de colaboración. Los datos ofrecidos por PITEC están basados en la Encuesta Comunitaria de Innovación (*Community Innovation Survey*), un plan coordinado por instituciones como la Comisión Europea y la OECD para obtener información de factores de innovación tecnológica (Arranz y Fdez. de Arroyabe, 2008). En particular, en este capítulo se trabajó con los datos que el Instituto Nacional de Estadística español recopiló para PITEC durante el periodo de 2009-2011, a través de cuestionarios postales que los directivos de las compañías completaron y devolvieron en un plazo de 15 días. Como se destacó anteriormente, se vuelve a realizar un análisis en el contexto geográfico español, si bien ahora se cuenta con una muestra mucho más amplia, ya que un total de 5389 empresas de base tecnológica se incluyeron finalmente en el estudio. En último término, cabe señalar que, para realizar el análisis empírico del modelo propuesto, se utilizó una regresión jerárquica binomial negativa, llevada a cabo con el SPSS Statistics 20. La elección de esta técnica está basada en literatura previa que la considera idónea cuando se trabaja con datos de conteo (ej. patentes de una empresa) (Somaya et al., 2007).

En resumen, el carácter actual y relevante del tema de investigación presentado, las contribuciones teóricas y prácticas realizadas, y la rigurosidad en la metodología utilizada, hacen que esta tesis tenga los requisitos básicos que todo trabajo científico de interés ha de poseer. Además, el hecho de que gire en torno al análisis de empresas de base tecnológica refuerza su atractivo, puesto que las mismas han recibido una atención incremental por parte de gobiernos y académicos en los últimos tiempos, dadas sus altas expectativas en términos de desempeño y potencial para afectar el crecimiento económico de un país (Teixeira y Tavares-Lehmann, 2014).

1.2. Objetivos de la Investigación

De forma genérica, el objetivo primordial de este trabajo de investigación consiste en examinar las consecuencias derivadas de la gestión de la tecnología a nivel organizativo en empresas de base tecnológica. En primer lugar, se analizará cómo influye la gestión de los activos tecnológicos y de conocimiento, llevada a cabo de forma estratégica, en el desarrollo de nuevos recursos (ej. habilidades tecnológicas), capacidades (ej. innovación), y procesos organizativos (ej. creación nuevos negocios) susceptibles de producir mejoras en el desempeño organizativo. Posteriormente, se evaluará (teórica y empíricamente) el impacto derivado en el desempeño organizativo, medido en términos estratégicos y financieros, y de generación de nuevo conocimiento. Como propósito adicional, se estudiará la importancia del apoyo de la alta dirección a la tecnología y la promoción de la orientación tecnológica a nivel organizativo como requerimientos para impulsar una gestión tecnológica orientada al éxito empresarial.

Si bien, en líneas muy generales, éstos son los objetivos centrales de este trabajo de investigación, han de señalarse también una serie de objetivos específicos adicionales.

En el capítulo 2 se pretende, en el contexto de las empresas españolas de alta tecnología:

- Establecer un marco de referencia que clarifique el rol estratégico que desempeñan el conocimiento y los recursos y competencias de tipo tecnológico.
- Determinar la influencia potencial que puede tener el apoyo de la alta dirección a la tecnología en la generación de habilidades tecnológicas, competencias tecnológicas distintivas, y aprendizaje organizativo.

- Analizar si las organizaciones pueden mejorar sus niveles de aprendizaje gracias al desarrollo de competencias tecnológicas distintivas.
- Explorar si las empresas que se caracterizan por poseer mayores competencias tecnológicas distintivas, y promover culturas de aprendizaje organizativo, son capaces de ser más innovadoras.
- Mostrar, aportando evidencia empírica, el impacto tanto directo como indirecto que el apoyo de la alta dirección a la tecnología, las habilidades y competencias tecnológicas, y el aprendizaje tienen sobre el desempeño organizativo.
- Comprobar si, en efecto, aquellas empresas más innovadoras consiguen alcanzar mejores resultados económicos y financieros. O, si por el contrario, el coste asociado al desarrollo de esas innovaciones perjudica al desempeño organizativo.

El capítulo 3 persigue, en el contexto de las empresas europeas de alta tecnología:

- Analizar la influencia del aprendizaje organizativo en la creación de nuevos negocios en empresas de base tecnológica.
- Clarificar la importancia que tiene el desarrollo de una orientación tecnológica estratégica a nivel corporativo.
- Explorar si las empresas que aprenden y que promueven la orientación a la tecnología en la organización presentan una tendencia más fuerte a crear nuevas líneas de negocio, dado que se benefician de más fuentes de conocimiento y mayores activos tecnológicos.

- Analizar el papel estratégico de la creación de nuevos negocios en empresas establecidas, como una de las dimensiones críticas del espíritu emprendedor corporativo.
- Evaluar empíricamente si la creación de nuevos negocios, que de por sí conlleva potenciales beneficios, pero también importantes inversiones, contribuye a mejorar, o no, el desempeño financiero de las empresas de alta tecnología.

En último término el capítulo 4, en el marco de empresas españolas de base tecnológica, presenta los siguientes objetivos específicos:

- Explicar la relevancia de la I+D y las patentes en los actuales entornos de negocio, como recursos tecnológicos claves para promover la creación de nuevo conocimiento, invenciones, y nuevas fuentes de ventaja competitiva.
- Mostrar el rol estratégico de las redes de colaboración en las empresas de base tecnológica en la era de la globalización.
- Profundizar el estudio de la relación entre I+D y patentes, al analizar si la participación en distintas redes de colaboración geográficas influye en la propensión de la empresa a patentar los resultados generados a través de su I+D.

1. 3. Estructura del trabajo de investigación

En la presente tesis doctoral se incluyen, además de este capítulo de introducción, tres capítulos para desarrollar más específicamente la temática central de este estudio y un capítulo final de conclusiones.

El capítulo 2, "Technological distinctive competencies and organizational learning: Effects on organizational innovation to improve firm performance", parte de la premisa de que la gestión y la implantación tecnológica, a nivel organizativo, se ha configurado como un aspecto clave en los últimos tiempos en entornos turbulentos y cambiantes, con el objeto de garantizar el éxito organizativo (Drejer y Riis, 1999; Haro et al., 2010; Hussinger, 2010). Por esta razón, cada vez más empresas promueven una estrategia tecnológica proactiva, ya que los activos tecnológicos son críticos para crear productos o servicios innovadores, hacer frente a las situaciones de alta competitividad global, o aprovechar las oportunidades derivadas del cambio tecnológico (Huang, 2011; McEvily et al., 2004). Este capítulo analiza cómo influye el apoyo de la alta dirección a la tecnología, como motor impulsor del desarrollo tecnológico en la organización (Fernandes et al., 2006; Lanctot y Swan, 2000; Liang et al., 2007), en la generación de habilidades y competencias tecnológicas distintivas, así como aprendizaje organizativo. Además, se profundiza en el impacto que potencialmente puede tener el desarrollo de dichas competencias tecnológicas y aprendizaje organizativo en la innovación y la mejora del desempeño empresarial.

El valor y la contribución principal de este análisis radica en que se ofrece evidencia teórica y empírica de que el apoyo a la tecnología, impulsado por la alta dirección, constituye una fuente de ventaja competitiva para las organizaciones de base tecnológica (Levitas et al., 2006; Martín et al., 2013). Esto se debe a los efectos positivos que se derivan para la creación de nuevo conocimiento, y habilidades y competencias tecnológicas, los cuales nutren la capacidad de innovar de las organizaciones. Como resultado, no sólo las empresas tecnológicas se encuentran en mejor posición para hacer frente a la turbulencia del entorno en el que operan, sino que también son capaces de mejorar su desempeño económico y financiero.

El capítulo 3, “Organizational learning and new business venturing: The moderating role of the firm's technological orientation", se basa en la idea central de que las empresas han de beneficiarse de nuevos flujos de conocimiento y promover actividades de emprendimiento corporativo, como la creación de nuevos negocios, para garantizar mejoras en su desempeño y su propia supervivencia (Burgelman y Valikangas, 2005; Narayanan et al., 2009). Partiendo de esta idea, se explora si aquellas empresas que promueven el aprendizaje organizativo, y por tanto generan más conocimiento relativo a los mercados, clientes, o avances tecnológicos, son más propensas a lanzar nuevos negocios, basados en una mayor habilidad para crear nuevos productos y servicios y conocer mejor las necesidades de sus clientes (Ravasi y Turati, 2005). Además, y de forma muy importante, en esta investigación se analiza si el hecho de que la empresa promueva una orientación a la tecnología de forma activa a nivel corporativo potenciaría (o no) su tendencia a impulsar nuevos negocios. En este sentido, cabe destacar que tanto el aprendizaje como la orientación a la tecnología pueden complementarse y así reforzar los activos basados en el conocimiento, que constituyen un recurso crítico para emprender la creación de nuevos negocios (Covin y Miles, 2007; García et al., 2013). Sin embargo, ha de tenerse en cuenta que no siempre es fácil integrar el conocimiento y las tecnologías existentes con los nuevos recursos generados por el desarrollo de una estrategia basada en el apoyo a la tecnología. Este motivo podría dificultar las acciones encaminadas a la expansión de los negocios actuales (Garrett y Covin, 2013). Ante la inexistencia de estudios concluyentes en esta materia, se pretende analizar en detalle esta cuestión para así ofrecer una visión que clarifique los argumentos contradictorios que aún persisten.

La principal aportación realizada radica en verificar las sinergias que pueden derivarse de la combinación del conocimiento, generado a través del aprendizaje organizativo, y la promoción tecnológica a nivel corporativo (Kim et al., 2013; Martín et al., 2013; Newbert et al., 2007), ya que contribuyen a fomentar las actividades de creación de nuevos negocios. La expansión empresarial, a través de nuevas líneas de negocio, es clave para favorecer la renovación estratégica y, además, facilita mejoras en el desempeño organizativo (Garvin, 2004; Zahra et al., 2006).

El capítulo 4, "The relation between R&D spending and patents: The moderating effect of collaboration networks", se centra en profundizar la relación entre inversión en I+D y propensión a patentar. Concretamente, se analiza si las empresas de base tecnológica que forman parte de redes de colaboración nacionales, regionales, o más internacionales, presentan una propensión a patentar más fuerte que las que se mantienen fuera de estas redes. Por un lado, establecer colaboraciones con otros socios, tales como universidades, laboratorios de investigación, otras empresas, etc., favorece el acceso a mayores flujos de recursos y conocimiento, un *input* determinante para patentar (Noseleit y de Faria, 2013). Por otro, y no obstante, la localización de estos socios condiciona la naturaleza de los activos adquiridos en las redes de colaboración (Vasudeva et al., 2013). En este sentido, parece razonable pensar que, ante culturas, lenguaje, y habilidades similares, las empresas tenderán a patentar más cuando combinan su I+D interna con los activos de conocimiento y tecnología obtenidos en redes de colaboración más cercanas, esto es, nacionales y regionales (Berry, 2013). Sin embargo, es posible que cuando colaboran con socios más lejanos geográficamente, surjan mayores dificultades para transferir e integrar el conocimiento de las redes con la I+D empresarial (Szulanski, 1996). En estos casos, y ante estas disfunciones, las combinaciones de recursos serían menos fructíferas en términos de patentes.

Los resultados de este estudio constatan que aquellas empresas de base tecnológica que participan en redes nacionales y regionales muestran una propensión a patentar los conocimientos derivados de su I+D más intensa que las empresas que no colaboran. Por el contrario, la participación en redes más internacionales, pese a incrementar las fuentes de recursos y conocimiento accesibles, no ejerce ninguna influencia en la relación entre inversión en I+D y propensión a patentar. Así, y de forma global, esta investigación avanza el campo de la estrategia tecnológica en I+D y patentes, el rol estratégico de las redes de colaboración, y la teoría de la empresa basada en el conocimiento. Estas aportaciones se presentarán con más detalle al final de esta tesis.

En último término, el capítulo 5 recoge y analiza minuciosamente las principales conclusiones e implicaciones de este estudio en su conjunto. Además, se presentan las limitaciones más relevantes de este trabajo, así como futuras líneas de investigación que se pueden derivar en este contexto.

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CAPÍTULO 2

TECHNOLOGICAL DISTINCTIVE COMPETENCIES AND ORGANIZATIONAL LEARNING: EFFECTS ON ORGANIZATIONAL INNOVATION TO IMPROVE FIRM PERFORMANCE

Technological distinctive competencies and organizational learning: Effects on organizational innovation to improve firm performance

Abstract

This paper analyzes how top management support of technology influences the generation of technological skills, technological distinctive competencies and organizational learning. We also examine the effects of technological distinctive competencies and organizational learning on organizational innovation and reflect how all of these variables impact organizational performance. The results of our empirical analysis, based on a sample of 201 Spanish technological firms, suggest that: 1) top management support positively influences the generation of technological skills, technological distinctive competencies and organizational learning; 2) technological distinctive competencies and organizational learning positively affect organizational performance, directly and indirectly through organizational innovation.

Keywords

Top management support, technological distinctive competencies, organizational learning, organizational innovation, organizational performance

JEL classification

O32, O33, Q55

2.1. Introduction

Recently, firms have been operating in business environments characterized by rapid change and increasing competitiveness (Hitt et al., 2000). In this context, technology and its relationships to organizational structures, processes and results have been conceived as an important subject of interest for organizational researchers (Orlikowski, 2000), since they enable organizations to develop products or delivery of services more quickly in highly competitive situations on a global level, as well as continuous technological change and ever shorter product life cycles (García et al., 2007b).

When faced with such scenarios, firms must innovate continuously to guarantee their organizational survival (Hurley and Hult, 1998). Innovation must be driven by the capability to exploit organizational competencies, technologies and knowledge in order to stimulate competitive advantages (DeCarolis, 2003). Firms are under increasing pressure to foster "organizational learning" and develop, strengthen and renew "technological competencies." These competencies enable firms to adapt, integrate and reconfigure their skills, knowledge and capabilities. In doing so, they adapt to the changing business environment and deliver value to the customer in the appropriate form, responsibly and continuously (Wang et al., 2004; García et al., 2007b).

In this research, we present a model to analyze the importance of top management support in the effective adoption and implementation of new technologies in organizations and, more specifically, in the generation of technological distinctive competencies, technological skills and organizational learning. This study will also contribute empirical evidence of the effects of technological distinctive competencies and organizational learning on organizational innovation and demonstrate how all of the foregoing influence organizational performance. Prior studies have analyzed the relation between some of the foregoing constructs; for example, support from management and effective implementation of specific technologies, such as information systems (Young and Jordan, 2008) and the influence of technological distinctive competencies on organizational performance (Lee et al., 2001; Wang et al., 2004). There is, however, no integrated model of all of these systems in the literature, nor is there a model that focuses on the broad concept of technology. We would also point out that the analysis proposed does not only explain how to achieve improvement in organizational performance through direct relationships with strategic variables such as technological distinctive competencies and organizational learning. It also introduces indirect relationships, in this case through innovation, which can achieve the same goal. We therefore find an innovative model with great potential that enables organizations not only to survive in turbulent and changing environments but also to improve their competitive position. We will perform this analysis within the framework of technology firms. We choose this type of firm because of its current importance in modern economies, due to its contribution to economic growth, increase in productivity and creation of new, innovative industries, products and processes (Grinstein and Goldman, 2006).

This study provides an explanation of the crucial role that top management support of technology plays in the process of stimulating technological skills, technological distinctive competencies and organizational learning. Top management includes the "CEO and its direct subordinates responsible for corporate policy" (Green, 1995, p. 223). Different studies have shown that, when top management's level of support and commitment is perceived as high, it is logical to expect the success of the system (Ifinedo, 2008). Managers must be willing to allocate adequate capital and human resources (Carbonell and Rodríguez, 2009). Although some authors have shown that this support is essential for the successful implementation of specific technology, such as information systems (Dong, 2008), few studies in the existing literature analyze how this support affects the process of technology implementation in general. We must therefore take into account a much wider concept of technology: a body of knowledge, tools, and techniques derived from science and practical experience and used in the development and application of products, processes, systems, and services (Steensma, 1996).

The influence of top management support on technological distinctive competencies may also be stimulated by the development of technological skills, which in a technological context refer to both firm-specific techniques and scientific understanding (Leonard-Barton, 1992). These skills provide the basis for a firm's competitive competencies (Teece, 1986). The "myth of deskilling" wrongly encourages managers to expect that new equipment will enable a reduction of required skills. This myth is one of the greatest obstacles to the effective implementation of new technologies (Swamidass and Nair, 2004). The generation of required skills is thus a crucial question, since it can also have repercussions for the generation of competencies, as competencies reflect a set of skills and technologies (Peppard and Ward, 2004). Another important issue is determining how the top management support can foster organizational learning. The promotion of continuity, commitment, capability, contribution, collaboration and consciousness of organizational learning is in the hands of top management (García et al., 2007b). It is top management's task to stimulate the creation of organizations that adopt a learning culture (Real et al., 2006). The literature has shown that this result can be achieved through the creation of a shared vision, team learning, personal mastery and mental models (Senge, 1990). Our study also treats how organizational learning can be encouraged by involving top management in the processes supporting new technologies (Robey et al., 2000). It therefore shows how top management support affects organizational learning (Andrawina, 2009).

The literature on organizational learning has grown exponentially in recent years (Bontis et al., 2002; Nonaka and Takeuchi, 1995; Real et al., 2006). Organizational learning has been defined as a collective capability based on experiential and cognitive processes and involving knowledge acquisition, knowledge sharing, and knowledge utilization (Aragón et al., 2007; Zollo and Winter, 2002). More synthetically, organizational learning has been catalogued as a complex process related to the development of new knowledge (Huber, 1991; Slater and Narver, 1995). Learning processes are intrinsically social and collective phenomena (Carayannis et al., 2006). Thus, a culture of learning in which people work together enables organizations to establish themselves by fostering and maintaining a system of knowledge creation (Wang et al., 2007). Various authors have proposed that, to maintain their competitive advantages, organizations should strive to develop continuous learning (Jiménez and Sanz, 2011; Senge, 1990; Zott, 2003). The concepts of learning and knowledge creation have also acquired special relevance because they are often used to describe the innovation process (Nonaka and Takeuchi, 1995). More than ever, organizational learning is a need rather than a choice (Senge, 1994).

In recent years, there has been marked interest in the idea that competencies constitute the foundation for obtaining sustainable competitive advantages over time (Wu, 2009). Competencies are conceptualized as "measurable patterns of knowledge, skills, abilities, behaviors, and other characteristics that differentiate high from average performance" (Wu, 2009, p. 9575). Following this concept, technological distinctive competencies can be defined as "the organization's expertise in mobilizing various scientific and technical resources through a series of routines and procedures which allow new products and production processes to be developed and designed" (Real et al., 2006, p. 508; Martín et al., 2011). Although various authors use the terms "technological capabilities" (Figueiredo, 2002; Lall, 1992; Silvestre and Dalcol, 2009) rather than "technological distinctive competencies" (Real et al., 2006; Martín et al., 2011), our study uses the concept of "technological distinctive competencies," since it fits better with our research goals. The term capability has been defined as "the firm's ability to perform repeatedly a productive task which relates either directly or indirectly to a firm's capacity for creating value through effecting the transformation of inputs into outputs" (Grant, 1996b, p. 377). As Marino states (1996, p. 41), "competencies have a technology or knowledge-based component. In particular, competencies often result from a blending of technology and production skills. Capabilities, on the other hand, are rooted more in processes and business routines." For this reason, we focus on technological distinctive competencies in the framework of our research. These include, among others, the competencies to obtain information on the state and progress of the relevant science and technologies, to generate advanced technological processes, to update and introduce new innovations based on technologies, to attract and retain qualified technical personnel, to achieve the technological differentiation of products and to assimilate new technologies (Real et al., 2006). Some authors have stressed that technological distinctive competencies drive the development of organizational learning (Prencipe, 1997), since the competencies require change over time to maintain their value, a quality that emphasizes the processes of developing knowledge and learning (McEvily et al., 2004). There is, then, a relationship between technological distinctive competencies and organizational learning (Tippins and Sohi, 2003).

In analyzing the influence of technological distinctive competencies and organizational learning on organizational innovation, this research focuses on innovation at the organizational level, which has been defined as "the development and/or use of new ideas or behaviors. A new idea can pertain to a new product, service, market, operational and administrative structures, processes and systems" (Damanpour et al., 2009; p. 652). Following most of the studies of the adoption of innovation at the firm level, we thus define innovation as "new to the adopting organization" (Damanpour et al., 2009; p. 652). Such is the importance of innovation that it has been generally considered one of the key factors leading to corporate success, as it enables firms to negotiate the turbulence of the external environment in especially dynamic markets (Jiménez and Sanz, 2011). Despite the clear and evident advantages derived from it, innovation is not a problem-free process. Innovations are increasingly complex, costly and risky due to changes in consumer preferences, pressure from competitors, and rapid and radical technological changes (Griffin, 1997). Although this difficulty is recognized, promoting innovation is the basis for achieving both sustainable competitive advantages (Chen and Jaw, 2009) and organizational survival (Damanpour and Evan, 1984; Hurley and Hult, 1998).

Finally, we will also deepen understanding of the effects of technological distinctive competencies, organizational learning and organizational innovation on organizational performance. We use organizational performance to refer to both strategic market performance - which includes market share and sales growth rate- and financial market performance -which involves return on sales, return on investment and return on equity (Murray and Kotabe, 1999). Prior studies state that firms possessing technological distinctive competencies (such as the competence to apply scientific and technological knowledge to develop and improve products and processes) tend to be more innovative and thus usually to obtain much better performance (McEvily et al., 2004). Also, it has been established that organizational learning is a determinant of improvement in organizational results (e.g., Carayannis et al., 2006; Leonard-Barton, 1992). To this we must add the crucial importance of organizational innovation, which is necessary for firms to acquire better organizational performance (Thornhill, 2006; Weerawardena et al., 2006). In sum, we will indicate how to improve organizational performance through all of the strategic variables presented above.

To achieve these objectives, this study is structured as follows. Section 2, based on prior research, proposes a series of hypotheses. Section 3 presents the data and the research methodology used in this empirical analysis to test the hypotheses developed in Section 2. Section 4 shows the results obtained. In Section 5, we present the discussion and implications of this research. Section 6 explains the conclusions of this study. Finally, Section 7 establishes some limitations and lines for future research.

2.2. Hypotheses

2.2.1. The influence of top management support on technological skills

Nowadays, organizations must both acquire and maintain access to new technologies and be able to make effective use of them to maintain and improve their competitive advantages (Weigelt, 2009). In order to best utilize the technology available, firms are placing more emphasis on obtaining higher technological skill levels (Campbell and Warner, 1992). The use of technologies may lead to higher-quality products. The utilization of computer-integrated manufacturing may improve the speed of production as well as product flexibility. The adoption of e-business tools may enhance the worker's productivity in sectors such as electronics and general machine sector. However, to achieve these goals, organizations must invest in technological skills and knowledge upgrading (Oyelaran-Oyeyinka and Lal, 2006). In such scenarios, support from management is crucial, as management is responsible for orchestrating and optimizing the use of technology and human resources (Pinheiro, 2010).

Some authors have demonstrated a relationship between top management support and the development of technological skills (Cyert and Mowery, 1987; Greenan, 2003; Dong, 2008; Mahmood, 2003; Štemberger et al., 2011). Climbing the technological ladder requires updating of skills by learning new technologies (Oyelaran-Oyeyinka and Lal, 2006). Top management can support technology training programs, whose main purpose is to produce users with practical technological skills that enable them to use technology applications. Such programs also seek, however, to create motivated users able to apply learned technological skills to their jobs, users who can continue to learn as skill and technology requirements change (Sein et al., 1999;

Mahmood, 2003). Thus, top management support enables the creation of more stimulating work environments for technical subordinates, which offer greater opportunities for learning, growth and the development of technological skills (Cordero et al., 2004). This aspect becomes essential when considering the positive impact that the accumulation of technological skills may have on important variables such as productivity, quality of products (Oyelaran-Oyeyinka and Lal, 2006), potential to absorb external knowledge (Lin, 2007), education of employees (Sein et al., 1999), growth and profitability (Swamidass and Nair, 2004).

Top management support and participation reflect the importance that top management executives place on technology (Byrd and Davidson, 2003). Beath (1991) found top managers to be the most important antecedent to successful implementation of technology because they are able to bring about organizational change. The increasing level of technological skills in the workforce complements the change that comes with the decision to support new technologies, computerization and the adoption of internal electronic tools within firms (Goldin and Katz, 1998; Greenan, 2003). When top management supports the decision to develop new technologies, organizations expand their existing knowledge or experience (Schilling and Hill, 1998). Through these organizational changes and facilitation of the learning curve on new technologies (Greenan, 2003), one can expect that employees' technological skills will increase (Peterson and Van Fleet, 2004). Based on the foregoing, we propose the following hypothesis:

Hypothesis 1. Top management support will be positively related to technological skills.

2.2.2. The influence of top management support and technological skills on technological distinctive competencies.

Business environments and society in general have been undergoing constant transformation in recent years by a series of factors, among which are globalization, the knowledge revolution and the rapid dissemination of new technologies (Ireland and Hitt, 1999). So great is the importance of this last factor that different authors have shown how firms should adopt and assimilate these technologies if they wish to maintain and improve their competitive advantage (Lee and Grewal, 2004). In this context, the modernization of firms to adapt to new technologies involves a series of changes that refer, in terms of the factor of capital, to replacing old equipment with new (often introducing greater communications technologies) and, in terms of work, to investment in new skills and competencies to face new needs (Greenan, 2003). Along these lines and given their importance, the literature on management has focused recently on how organizations can develop and exploit critical competencies on the global market (Steensma, 1996; Wu, 2009), such as technological distinctive competencies (Teece et al., 1994). Management plays a decisive role in developing these competencies, which we will analyze in what follows.

Thanks to the support of top management executives—reflected among other issues in the financing dedicated to technologies and to the role these executives play in the implementation, use and success of technologies in organizations (Byrd and Davidson, 2003), firms can foster technological distinctive competencies such as the competency to assimilate new technologies, to maintain their position on the technological vanguard in their sector, or to remain up to date and introduce innovations based on information technologies (Real et al., 2006). Without top management support, this technological assimilation would not occur (Armstrong and Sambamurthy, 1999). This phenomenon accentuates the important role that managers perform in obtaining the maximum potential from the technology (Booth and Philip, 1998). According to the foregoing, top management support may, through the identification of technological projects (Melville et al., 2004), be related to the generation of sources of technological distinctive competencies, which involves both exploration and exploitation of technological opportunities (Huang, 2011). As March (1991) pointed out, both exploration and exploitation are essential and must be balanced within firms. Exploration involves actions captured by terms such as search, risk taking, experimentation or discovery. Exploitation includes such actions as refinement, selection, efficiency, implementation and execution. Effective selection among routines or practices is crucial to survival, but so is the generation of new alternative practices, especially in a changing environment.

The promotion and securing of resources devoted to R&D in technology, as well as the measure of support from management (Byrd and Davidson, 2003), stimulates organizations' technological distinctive competencies. These affect the work climate of R&D (itself a source of technological competencies), the capability to link the R&D plan to the competitive strategy, the capability of achieving effective collaboration with other organizations in R&D, and effective installation of programs oriented to the development of technological competencies (Huang, 2011; Real et al., 2006). Such effects also occur when management takes charge of facilitating technology transfer throughout the firm—which has different levels of the transfer of expertise or know-how, since much knowledge is incrusted in technology (Malik, 2002)—and promotes the creation of technological distinctive competencies, such as the capability to develop knowledge management programs, that guarantee the competency to generate technology or to absorb it from other organizations (Real et al., 2006).

Technological changes altering the market recently show the need for firms to possess competencies to maintain themselves strategically (Drejer, 2001). Through top management support, fostering technology (Schepers et al., 2005) can develop technological distinctive competencies that make key contributions to increase the firm's competitive advantage (Irwin et al., 1998; Peteraf and Bergen, 2003). Managers must be responsible for examining the threats that new technologies present and the need to maintain the organization's capabilities (Smith and Sharif, 2007). Based on the foregoing, we propose the following hypothesis:

Hypothesis 2. Top management support will be positively related to technological distinctive competencies.

The disposition to acquire technology has been conceived as characteristic of the most successful organizations (Kim and Pae, 2007). Making the right decision about opportunities for technology investment can provide organizations with considerable operating and competitive benefits (Torkkeli and Tuominen, 2002). These characteristics should be reinforced by sufficient preparation at the organizational level. Organizations must not only be willing to adopt new technologies but also to use them to the best advantage in order to obtain the benefits indicated above. Because this preparation reflects the firm's capability to adopt and use new technological resources (Parasuraman, 2000), appropriate technological preparation is required. In such scenarios, technological skills are strategic, as they can achieve effective implementation of new technological processes (Swamidass and Nair, 2004).

Various studies indicate the existence of a relationship between technology skills and technological distinctive competencies. Some authors argue that the concept of competency reflects a set of skills and technologies (Peppard and Ward, 2004). One key to developing organizational competencies is the possession of technical skills, as well as organizational processes to exploit those skills (Caldeira and Ward, 2003). To obtain business benefits derived from investments in technology, organizations should develop competencies that exploit these technologies, competencies that involve a series of individual skills (Wu, 2009). We can define the competency as an underlying element that projects itself as skilled behaviour. This definition is based on the very concept of competency as involving a series of skills related, among other things, to the effective performance of management functions and personnel behaviour that enables employees to perform their functions satisfactorily and permits differentiation of employees with superior performance (Rajadhyaksha, 2005).

Competencies involve a series of models of behaviour required to achieve effective organizational performance. They imply not only skills, but also how to apply these skills effectively in a specific area to achieve successful performance (Sgobbi, 2002). In the area of technology, increase in the personnel's technological skills will facilitate the development of technological distinctive competencies (Caldeira and Ward, 2003; Real et al., 2006). We can thus show the interconnection between technological skills and technological distinctive competencies, which is consistent with studies that indicate that organizational competency emerges from the understanding of business processes and of individual skills (McGrath et al., 1995).

Ultimately, the implementation of technologies is often accompanied by the development of new skills and knowledge. The latter are necessary for professionals to be able both to manage increasingly complex systems (Schramm, 2006) and to avoid the failure of technologies due to the scarcity of technological skills (Booth and Philip, 1998). The incorporation of new technological skills is related to the generation of technological distinctive competencies, since technological distinctive competencies involve the implementation and extension of the reach and consequences of different organizational capabilities. These in turn require the mastery of technological skills (Miyazaki, 1999). Based on the foregoing, we propose the following hypothesis:

Hypothesis 3. Technological skills will be positively related to technological distinctive competencies.

2.2.3. The influence of top management support and technological distinctive competencies on organizational learning

Because scientific and technological advances occur constantly and because market needs change continuously, organizations must learn to respond increasingly quickly and satisfactorily to turbulent and uncertain environments (Lynn et al., 2003). The greater the commitment from the organization's management to implement new technologies and the more resources it devotes to this end, the more processes it will encourage that integrate organizational learning. Support for the introduction of new technologies provides a clear example. At the organizational level, such introduction incorporates an important factor for the design of learning organizations in providing an infrastructure to store, access and review some of the elements that make up organizational memory (Robey et al., 2000). We have shown that there is a positive relation between the incorporation of information technologies and organizational learning, a relationship established when the right culture exists (Real et al., 2006).

Top management executives' support of the implementation, use and success of technologies is key for their firms' assimilation of these technologies at the organizational level (Armstrong and Sambamurthy, 1999). Such support will lead, further, to obtaining higher levels of organizational learning, as Ruiz et al., (2006) have shown for the case of small firms that make greater use of individual and collaborative technologies. Along the lines described above, management's stimulation of projects in which e-learning technologies and techniques are used also helps to facilitate organizational learning through the transformation of tacit knowledge into explicit, knowledge that can be disseminated at the organizational level (Falconer, 2006).

Management can support another series of actions to facilitate organizational learning, such as the promotion of technology transmission projects. Such projects foster and affect the creation, acquisition and retention of knowledge (Gupta and Govindarajan, 2000), that is, the processes that integrate organizational learning. When firms make a commitment to carry out processes by developing new technologies, they are really fostering learning processes based on the creation of new knowledge (Manaikkamäkl, 2007).

Finally, top management support has the potential to influence organizational knowledge and learning in a significant way (Andrawina, 2009) through the promotion of technology. Firms that stand out as being technologically proactive and thus promote their own technological development will generate greater organizational learning (García et al., 2007b). Top management performs a crucial role, not only because it is responsible for securing the financial and personnel resources necessary (Thong et al., 1996) but also because it is critical in promoting changes at the organizational level (Dong, 2008). Based on the foregoing, we propose the following hypothesis:

Hypothesis 4. Top management support will be positively related to organizational learning.

Nowadays, firms face a situation of intense competitiveness, in which the key factor for competitive success lies in the capability constantly to develop new products, processes or services. Given this scenario, various studies have stressed the need for organizations to include technology in their corporate agendas (Kim and Pae, 2007) and to develop technological distinctive competencies that enable them to obtain benefits from the use of new technologies (Leonard-Barton, 1992).

Technological distinctive competencies are positively related to organizational learning (Tippins and Sohi, 2003). Organizations that develop technological distinctive competencies usually possess high potential to absorb technology, which enables them to understand others' technological mental models and ways of acting more easily, thereby achieving a shared vision of key technological assumptions and existing relationships and improving the capability to learn at the organizational level (García et al., 2007b; Senge et al., 1994). The development of central competencies in the organization, as in the case of technological distinctive competencies, encourages processes of organizational learning (Andreu and Ciborra, 1996) and stimulates organizational performance (DeCarolis, 2003).

Firm-specific technological distinctive competencies help to explain why firms are different, how they change over time, and whether or not they are able of remaining competitive (Patel and Pavitt, 1997). Technological distinctive competencies may become institutionalized over a long period of time and form part of the company's knowledge creation system (Leonard-Barton, 1992), which in turn affects the development of organizational learning (Huber, 1991). Considering that organizational learning is a change in the organization that occurs as it acquires experience, and that routines and beliefs change in response to direct organizational experience through trial-and error experimentation and organizational search (Levitt and March, 1988), the acquisition of technological distinctive competencies (the process by which organizations develop new technological competencies and renew existing ones) will foster the ability of the organizations to learn from experience. This is the case because the acquisition of technological distinctive competencies involves the assimilation or absorption of technological knowledge from other organizations and the creation of technological competence through processes such as search or experimentation (McEvily et al., 2004; Ahuja and Katila, 2001).

Thus, technological distinctive competencies increase the potential to absorb and manage technological knowledge and the capability to innovate, producing improvements in organizational performance (Wang et al., 2004). Employees with technological distinctive competencies can use information technologies more easily, facilitating organizational learning (Kautz and Thaysen, 2001). Based on the foregoing, we propose the following hypothesis.

Hypothesis 5. Technological distinctive competencies will be positively related to organizational learning.

2.2.4. The influence of technological distinctive competencies and organizational learning on organizational innovation

In recent years, various studies have shown that organizational innovation is essential for both organizational survival (Cavusgil et al., 2003; Han et al., 1998; Hurley and Hult, 1998) and organizational performance (Bret and Okumura, 1998; Smith et al., 2005). The set of competencies that each organization possesses plays a key role in the development of organizational innovation, since without these competencies the organization could not innovate in response to the rapid technological changes (Ahuja, 2000). In this context, and among these competencies, technological distinctive competencies merit special attention (Ritter and Gemünden, 2004).

Diverse studies stress the existence of a positive relationship between technological distinctive competencies and organizational innovation. DeCarolis (2003) argues that one of the basic functions of technological distinctive competencies is the exploitation of technological knowledge to develop organizational innovations satisfactorily. In analyzing exploiting competencies, Nerkar and Roberts (2004) emphasize that the ultimate reason that firms develop technological distinctive competencies has to do with the satisfactory development of new products. Firms deeply implicated in technological distinctive competencies in the long term increase their organizational innovation (Huang, 2011). Autio and Yli-Renko (1998) show that new technology firms enjoy a series of strengths that cannot be easily replicated by large companies, as is the case of technological distinctive competencies in highly specialized fields, which foster and contribute to high innovative efficiency.

We can conclude by stressing, as do Cantwell and Fai (1999, p. 333), that “while on the surface innovation is commonly observed through the market phenomena of the emergence of new products and the diversification of existing products, the underlying capability to change what markets receive is provided by the corporate capability to create and refine to a viable point new products and processes, which rests on the cumulative generation of technological competence in firms.” By means of technological distinctive competencies, organizations can become pioneers in the market by developing new products and new production processes (Ritter and Gemünden, 2004). Thus, technological distinctive competencies have a positive influence on innovative organizational performance (Huang, 2011). Based on the foregoing, we propose the following hypothesis:

Hypothesis 6. Technological distinctive competencies will be positively related to organizational innovation.

We are witnessing increasingly dynamic and competitive environments, in which organizational innovation constitutes the basis for sustaining competitive advantages (Nonaka, 2007), as well as the key to organizational survival (Damanpour and Evan; 1984; Hurley and Hult, 1998). Such organizational innovation depends on the knowledge base that the organization possesses, generated by organizational learning (Cohen and Levinthal, 1990; Nonaka and Takeuchi, 1995). Knowledge is a strategic variable not only in new firms that introduce new products or create new markets but also in already established firms that must innovate continuously to face the threat caused by the disruption, for example, of new technologies (Cefis and Marsili, 2005). It is necessary to stimulate the development of factors that drive innovation and enable the constant search for and introduction of new ideas, products, services, systems, policies, programs and processes before other firms in the environment do so (Llorens et al., 2005).

Diverse recent studies have shown the existence of a positive relationship between organizational learning and organizational innovation (e.g. Aragón et al., 2007; Calantone et al., 2002). Organizational innovation usually begins with the construction of a new kind of knowledge within the firm (Demarest, 1997). Organizational learning, a process related to the development of new knowledge (Huber, 1991), therefore affects organizational innovation, since knowledge creation enhances the introduction of new products and services (Smith et al., 2005).

Organizational learning "supports creativity, inspires new knowledge and ideas and increases the potential to understand and apply them, favours organizational intelligence and (with the culture) forms a background for orientation to organizational innovation" (García et al., 2007b, p. 535). Such learning facilitates the introduction of new products and services, the establishment of new markets and technologies, and firms' capability to adapt and change to respond to new market demands (Smith et al., 2005). Organizational learning can be market focused, internally focused and/or relationally focused, but it must influence organizational innovation (Weerawardena et al., 2006).

Along these lines, we can observe, on the one hand, that learning is an antecedent of innovation (Hurley and Hult, 1998) and, on the other, that the firms that create and use knowledge continuously and effectively are those most able to innovate rapidly and satisfactorily (Cavusgil et al., 2003). It is essential for organizations to possess the capabilities necessary for a learning organization or for evolving with the goal of acquiring these capabilities (Gilbert and Cordey, 1996). Organizations with high levels of commitment to learning tend to achieve much greater innovative orientation and activity (Ussahawanitchakit, 2008). For innovation to become a top priority in firms oriented to new technologies, it is necessary to have a high degree of effective organizational learning (García et al., 2007b).

In sum, organizational learning involves a commitment to learning in itself, an open mind and exchange of knowledge. These qualities promote a set of knowledge-questioning and knowledge-enhancing values that lead to the development of innovative products, services and technologies, as well as the exploration of new markets (Keskin, 2006; Slater and Narver, 1995). Based on the foregoing, we propose the following hypothesis:

Hypothesis 7. Organizational learning will be positively related to organizational innovation.

2.2.5. The influence of technological distinctive competencies, organizational learning and organizational innovation on organizational performance

Technological distinctive competencies have been linked to obtaining competitive advantage (Coombs and Bierly, 2006; Tyler, 2001). In this context, studies have demonstrated that, in turbulent environments, firms that define their business area based on their technological distinctive competencies achieve better organizational performance (DeCarolis, 2003). Malerba and Marengo (1995) prove that the level of technical competencies affects performance positively in Italian high technology firms. Lee et al. (2001) found a positive relationship between technological distinctive competencies and financial performance in new Korean technology firms. Lokshin et al. (2009) stress the crucial role that technological distinctive competencies play in the innovative performance of organizations, with the consequent positive effect that this has on organizational performance. Technological distinctive competencies stimulate organizational capability to recognize and apply new external knowledge, which is necessary to continue the development of competencies that generate higher organizational performance (Wang et al., 2004).

Technological distinctive competencies can provide firms with competitive advantages, not only in their current product lines but also in future business they have not yet conceived (Steensma, 1996). When firms "learn" and improve their technical and organizational skills, they not only manage to act more competently in their current activities but also acquire more capability to find other new activities in the process of expansion, generally in technology-related activities (Bachmann, 1998). Organizations that possess better technological distinctive competencies tend to be more innovative, which leads to obtaining higher organizational performance (McEvily et al., 2004). Based on the foregoing, we propose the following hypothesis.

Hypothesis 8. Technological distinctive competencies will be positively related to organizational performance.

Organizational learning has been considered a strategic variable for obtaining competitive advantages that are sustainable over time and for improving performance in organizations (Garvin, 1993; Jiménez and Sanz, 2011). Some studies show that organizational learning has a direct and positive influence on organizational performance (Carayannis et al., 2006; Senge et al., 1994); others stress that, due to their influence on innovation, this learning affects organizational performance indirectly (Nonaka and Takeuchi, 1995; Senge et al., 1994).

It would be wrong to state that an increase in organizational learning always leads to an increase in organizational performance, since this does not occur in all cases (Hoopes and Postrel, 1999). Understanding how organizational learning affects organizational performance, whether directly or indirectly, is quite complex, since we have little knowledge of the mechanisms through which organizational learning is transformed into improvements in performance (Snyder and Cummings, 1998).

Knowledge management and organizational learning attempt to drive the increase in the quantity and quality of performance, enabling firms to improve their sales, achieve more support and create, maintain and improve their customer base (García et al., 2007a). Organizations that have developed a strong culture of learning are good at the creation, acquisition and transfer of knowledge, as well as at the modification of behaviour to reflect new knowledge and perspectives (Huber, 1991; Garvin, 1993; Skerlavaj et al., 2007). Since knowledge is a strategic resource for organizations to acquire competitive advantage (Hitt et al., 2000), learning that takes place on different organizational levels usually has a positive relation to organizational performance (Bontis et al., 2002). Firms oriented to learning benefit in specific areas that usually increase organizational performance, such as greater flexibility and rapidity of response, enabling them to face new challenges and act before their competitors do (Slater and Narver, 1995). Further, these firms usually possess specific competencies (Lei et al., 1996) that other organizations do not, competencies generated through learning.

The same is true of orientation to the market which, combined with organizational capabilities such as the capability to apply learning, increases organizational performance (Day, 1994; Hurley and Hult, 1998). Only through organizational learning will it be possible to anticipate and understand customers' needs and thus to possess better state-of-the art technology and to acquire a much greater capability to understand rivals' strengths and weaknesses (Calantone et al., 2002).

In conclusion, the growing importance of the relationship between organizational learning and organizational performance has fostered recent analysis by various authors (e.g. García et al., 2007b; Zahay and Handfield, 2004). In spite of the difficulties involved in determining the benefits generated by learning—difficulties that on occasion seem to be hidden for different reasons or time lags or simply not captured due to inadequate perceptions in the firm (Senge et al., 1994)—there is empirical evidence of the impact of organizational learning or orientation to learning on the area of financial and non-financial performance in the literatures on marketing (Baker and Sinkula, 1999) and strategic management (Tippins and Sohi, 2003). As projected above, firms that learn and learn quickly manage to obtain a much greater strategic capability that enables them both to maintain a position of competitive advantage and to improve their results (Senge et al., 1994).

Based on the foregoing, we propose the following hypothesis.

Hypothesis 9. Organizational learning will be positively related to organizational performance.

Many studies in the literature have shown the existence of a positive relationship between organizational innovation and organizational performance (Schulz and Jobe, 2001; Weerawardena et al., 2006) or between certain characteristics or aspects of innovation (e.g., design, speed, flexibility) and organizational performance (Danneels and Kleinschmidt, 2001; García et al., 2007b). Other research has shown that not promoting innovative projects and activities influences both organizational productivity and performance negatively (Lööf and Heshmati, 2002). We must remember, however, that innovation is an expensive and risky activity. Although it usually influences the improvement of organizational performance, it may have drawbacks, such as greater exposure to market risks, increased costs, employee dissatisfaction and the generation of changes without guarantee (Simpson et al., 2006). In spite of these qualifications, the great majority of studies published on this issue agree that organizational innovation affects organizational performance positively (e.g., Bierly and Chakrabarty, 1996; Koc and Ceylan 2007).

Taking into account the rapid market changes occurring constantly in consumers' preferences and demands, competitors and technology (Calantone et al., 2003), those firms that possess greater innovation capability will be able to respond better to the turbulence in the environment (Jiménez and Sanz, 2011). Such response will permit them to increase organizational performance and consolidate a competitive advantage sustainable in the long term (Calantone et al., 2002; Hurley and Hult, 1998).

In recent years, due to the great interest awakened in the relationship between organizational innovation and organizational performance, different studies have provided empirical evidence on the positive nature of this relationship. Irwin et al. (1998) use the perspective of resources and capabilities to show the positive influence of technological innovations on organizational performance, holding that the characteristics of rareness, value and inimitability moderate this relationship. Other authors have shown that firms that adopt innovative product portfolios obtain a positive impact on organizational performance (Cho and Pucik, 2005). García et al. (2007a) stress that innovation and its capability to improve organizational performance influence not only large organizations but also small and medium-sized firms. In spite of having a smaller quantity of resources, these firms benefit from other aspects that stimulate innovation, such as greater flexibility, shorter decision chains, greater facility for detecting errors and learning from them, greater affinity with values and styles of leadership that facilitate communication and knowledge transfer, greater capability for customization, and higher employee motivation, among others (García et al., 2007a).

Finally, we can conclude that organizations continuously subjected to dynamic and changing environments innovate with the intention of improving their performance and effectiveness at the entrepreneurial level, grounding this conclusion in the positive relationship between organizational innovation and organizational performance (Aragón et al., 2007; Damanpour et al., 2009; Hurley and Hult; 1998; Thornhill, 2006). Based on the foregoing, we propose the following hypothesis.

Hypothesis 10. Organizational innovation will be positively related to organizational performance.

2.3. Methodology

This section presents the research methodology employed in this study. We first describe the sample used and then discuss how each of the variables included in the study is operationalized. Finally, we present the statistical analysis.

2.3.1. Sample and Procedure

The first necessary step in an empirical study is selecting the population to be analyzed. The population for this study consisted of the technological organizations possessing the greatest turnover in Spain. Technological organizations are firms that emphasize an orientation to R&D and innovativeness and entrepreneurship and that maintain a special pattern of work relations (a corporate culture of technology). These elements describe shared values, beliefs and symbols, as well as the way things are done in the firm (Grinstein and Goldman, 2006). The sample was selected by means of stratified sampling with proportional allocation (size and geographical location) from the Bradstreet (2003) database. Choosing a sample of firms located in a relatively homogeneous geographical, cultural, legal and political space enables us to minimize the impact of the variables that cannot be controlled in the empirical research (Hofstede, 1980). The Spanish market is relatively well developed and wholly integrated in the European Union. However, Spain is in a geographical area that has received relatively little attention from organizational researchers in the field of technological competencies. When compared with the European Union, it has a low level of technological capital per employee. Empirical research on technology in Spain is necessary to enable the improvement of the level of technology in the Spanish economy and to drive a new model of production for Spain (Aragón et al., 2007; Martín et al., 2011).

Drawing on our knowledge about key dimensions of this investigation, previous contacts with interested managers and scholars and new interviews with managers and academics interested in these strategic variables, we developed a structured questionnaire to investigate how organizations face these issues. We then established a reliable list of the CEOs of the organizations, with the help of partial funding from the Spanish Ministry of Science and Research and the Council for Economics, Innovation and Science of the Andalusian Regional Government. We omitted the responses of the interviewees in this first stage from the subsequent analysis of the survey data.

We decided to use CEOs as our key informants, because they receive information from a wide range of departments and are therefore a very valuable source for evaluating the different variables of the organization. They also play a major role in informing and moulding the variables under study by determining the types of behaviour that are expected and supported (Baer and Frese, 2003). Although numerous actors may be involved in the management process, the CEO is ultimately responsible for plotting the organization's direction and plans, as well as for guiding the actions carried out to achieve them (Westphal and Fredickson, 2001). The same types of informant were chosen, since this means that the level of influence among the organizations is constant, increasing the validity of the variables' measurements (Glick, 1985).

Surveys were mailed to the 1000 selected organizations along with a cover letter. We used this method because it enabled us to reach a greater number of organizations at a lower cost, to exert less pressure for immediate reply, and to provide the interviewees with a greater sense of autonomy. The cover letter explained the goal of the study and offered recipients the option of receiving the results once the study was completed. To reduce possible desirability bias, we promised to keep all individual responses completely confidential and confirmed that our analysis would be restricted to an aggregate level that would prevent the identification of any organization. We told interviewees that they would soon receive the questionnaire and reiterated the necessity that the person chosen answer it, even at the cost of receiving fewer responses.

We mailed each manager who had not yet responded two reminders. 226 valid questionnaires were returned, but because of missing values only 201 questionnaires were included in the research. The response rate was 20.1 % (Table 2.1). The possibility of non-response bias was checked by comparing the characteristics of the responding businesses with those of the nonresponding businesses. This analysis indicated that respondents did not differ significantly from nonrespondents with respect to return on assets, return on equity, return on sales or number of employees. Nor did we find significant difference between early and late respondents (Armstrong and Overton, 1977). Likewise, a series of chi-square and t-tests revealed no significant differences due to geographical location or size in the variables studied. Since all measures were collected with the same survey instrument, the possibility of common method bias was tested using Harman's one-factor test (see Konrad and Linnehan, 1995; Scott and Bruce, 1994). A principal components factor analysis of the questionnaire measurement items yielded five factors with eigenvalues greater than 1.0, which accounted for 72 percent of the total variance. Since several factors, not just one single factor, were identified and since the first factor did not account for the majority of the variance, a substantial amount of common method variance does not appear to be present (Podsakoff and Organ, 1986).

Table 2.1. Technical details of the research

Sectors / Size	1-49	50-250	+250	Total
High-tech services				
Computer science activities, research and development services	4	15	16	35
Postal and telecommunications services	4	19	11	34
High-tech manufacturing				
Chemical industry	0	19	6	25
Aerospace construction	4	18	3	25
Radio, television and communication manufacture	2	17	9	28
Office machinery and computer science equipment	3	18	4	25
Medical instruments, precision optics and watches	1	19	9	29
Geographical location	Spain			
Methodology	Structured questionnaire			
Procedure	Stratified sample with proportional allocation (size)			
Universe of population	50,000 firms			
Sample (response) size	1000 (201) firms			
Sample error	6.9%			
Confidence level	95 %, *p*-*q*=0.50; *Z*=1.96			
Period of data collection	From April 2010 to May 2010			

2.3.2. Measures

The use of constructs has played an important role in designing a survey instrument in management research. In any research concerning behavioural elements, no device using a single metric unit can measure precisely, and researchers usually employ two or more measures to gauge a construct or scale. Since developing new constructs or scales of measurement is a complex task, wherever possible we use pre-tested constructs from past empirical studies to ensure their validity and reliability.

Top management support. Using scales established by Byrd and Davidson (2003) and Ray et al. (2005), we drew up a four-item scale (Appendix) to reflect top management support. We developed a confirmatory factor analysis to validate our scales (χ^2_2=11.42; NFI=.99; NNFI=.98; GFI=.99; CFI=.99). The scale was unidimensional and showed high reliability (α=.926).

Technological Skills. We used the scales designed by Ray et al. (2005), Byrd and Davidson (2003) and García et al. (2007b) and established a scale of four items (Appendix) to reflect technological skills. Using a confirmatory factor analysis (χ^2_2=9.04; Normed Fit Index, NFI=.99; Non-Normed Fit Index, NNFI=.97; Goodness of Fit Index, GFI=.99; Comparative Fit Index, CFI=.99), we validated our scales and then verified each scale's unidimensionality and its high validity and reliability (α=.879).

Technological distinctive competencies. Using scales established by Real et al. (2006), we drew up a four-item scale (Appendix) to reflect technological distinctive competencies in the organization. We developed a confirmatory factor analysis to validate our scales (χ^2_5=16.86; NFI=.99; NNFI=.99; GFI=.99; CFI=.99). The scale was unidimensional and showed high reliability (α=.923).

Organizational Learning. We used the scale of four items developed by Aragón et al. (2007) and García et al. (2008) to measure organizational learning (Appendix). These items have been duly adapted to the present study. We developed a confirmatory factor analysis to validate the scales (χ^2_2=5.74, NFI=.99, NNFI=.99, GFI=.99, CFI=.99) and showed that the scale was unidimensional and had adequate validity and reliability (α= .908).

Organizational Innovation. We used the scale of four items developed by Zahra (1993) to measure organizational innovation (Appendix). These items have been duly adapted to the present study. We developed a confirmatory factor analysis to validate the scales (χ^2_9=19.47, NFI=.98, NNFI=.99, GFI=.99, CFI=.99) and showed that the scale was unidimensional and had adequate validity and reliability (α= .915). A 7-point Likert scale (1 '*totally disagree'*, 7 '*totally agree*') for this and all prior variables allowed managers to express agreement or disagreement.

Organizational Performance. Having reviewed how performance is measured in different works of strategic research, we used the scale of five items developed by Murray and Kotabe (1999). The use of scales for evaluating performance relative to the main competitors is one of the most widely-used practices in recent studies (Choi et al., 2008). Many researchers have used managers' subjective perceptions to measure beneficial outcomes for firms. Others have preferred objective data, such as return on assets. The literature has established widely that there is a high correlation and concurrent validity between objective and subjective data on performance, which implies that both are valid when calculating a firm's performance (Dess and Robinson, 1984; Homburg et al., 1999). We included questions involving both types of assessment in the interviews, but the CEOs were more open to offering their general views than to offering precise quantitative data. Subjective, self-reported performance measures such as those used in this study have been found to correlate highly with objective measures of firm performance (Venkatraman and Ramanujan, 1987). When possible, we calculated the correlation between objective and subjective data, and these were high and significant (0.762, $p<0.001$, for return on assets; 0.785, $p<0.001$, for return on equity; 0.822, $p<0.001$ for return on sales; and 0.819, $p<0.001$ for market share). We developed a confirmatory factor analysis to validate the scales (χ^2_5 = 34.92, NFI=.97, NNFI=.95, GFI=.98, CFI=.97) and showed that the scale was unidimensional and had high reliability (α= .867). We used a Likert-type 7-point scale (1 *"Much worse than my competitors,"* 7 *"Much better than my competitors"*) to ask about the organization's performance as compared with that of its most direct competitors.

2.3.3. Model and analysis

The data were analyzed through a structural equations model (LISREL 8.30 program), since there was an exogenous latent variable (top management support [ξ_1]), a first-grade endogenous latent variable (technological skills [η_1]) and second-grade endogenous latent variables (technological distinctive competencies [η_2], organizational learning [η_3], organizational innovation [η_4] and organizational performance [η_5]). This procedure enables us to translate the theoretical constructs into mathematical models so that the latter can in turn be estimated and evaluated empirically (Jöreskog and Sorbom, 1996). The hypotheses are given concrete graphic form in the theoretical model presented in Figure 2.1. We used a recursive non-saturated model. Structural equation modelling takes into account errors in measurement, variables with multiple indicators and multiple-group comparisons (Koufteros et al., 2009).

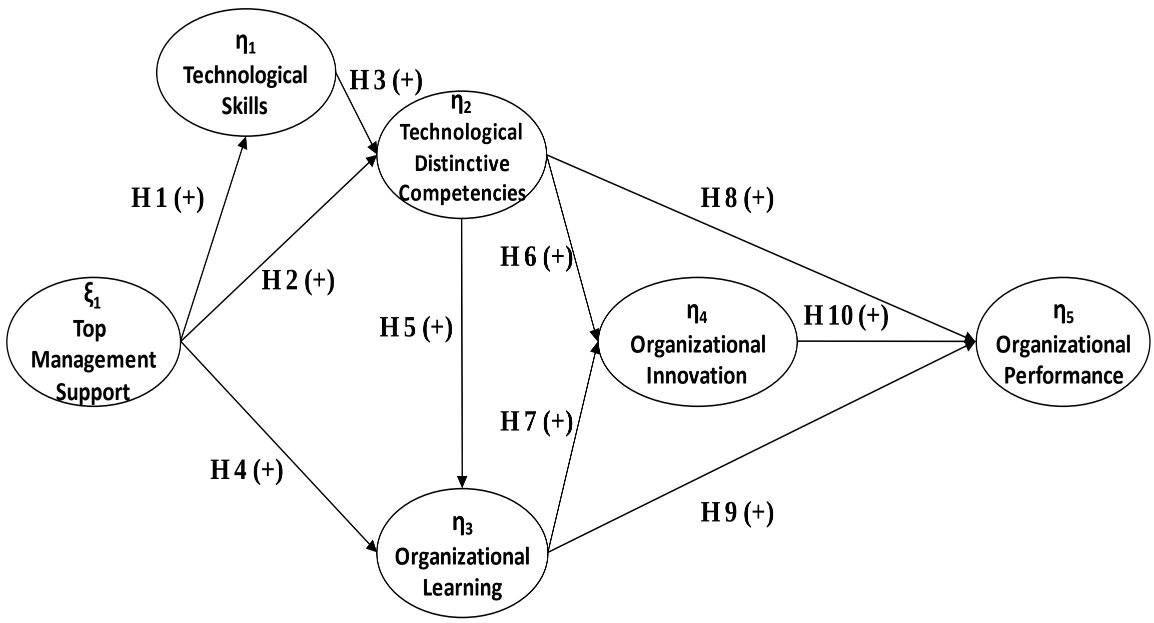

Figure 2.1. Hypothesized model

2.4. Results

In this section we present the main research results. First, Table 2.2 shows the means and standard deviations as well as the inter-factor correlation matrix for the study variables. There are significant and positive correlations among top management support, technological skills, technological distinctive competencies, organizational learning, organizational innovation and organizational performance. Second, structural equations modelling was performed to estimate direct and indirect effects using LISREL with the correlation matrix as input. This type of analysis has the advantage of correcting for unreliability of measures and also provides information on the direct and indirect paths between multiple constructs after controlling for potentially confounding variables. Figure 2.2 shows the standardized structural coefficients. The relative importance of the variables is reflected by the magnitude of the coefficients.

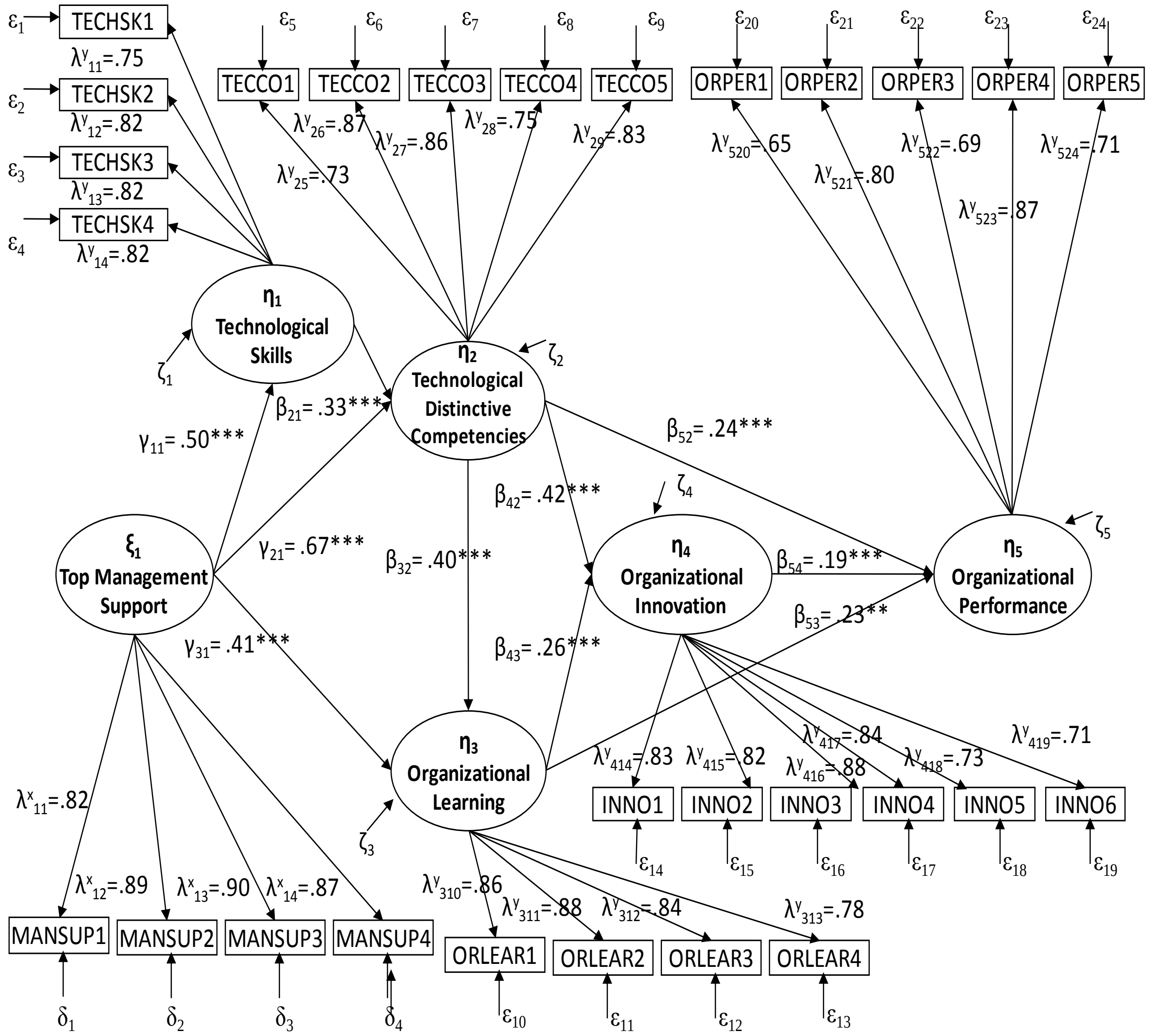

Figure 2.2. Results of structural equation model

Table 2.2. Means, standard deviations and correlations

Variable	Mean	S.D.	1	2	3	4	5	6
1. Top Management Support	4.706	1.438	1.000					
2. Technological Skills	4.891	1.280	.448***	1.000				
3. Technological Dist. Compets.	4.742	1.302	.622***	.557***	1.000			
4. Organizational Learning	4.791	1.404	.570***	.415***	.569***	1.000		
5. Organizational Innovation	4.171	1.367	.557***	.376***	.487***	.493***	1.000	
6. Organizational Performance	4.477	0.987	.390***	.353***	.438***	.464***	.413***	1.000

Note: *p<.05;**p<.01;***p<.001(two-tailed). n=201

In terms of the quality of the measurement model for the sample, the constructs display satisfactory levels of reliability, as indicated by composite reliabilities ranging from 0.87 to 0.92 and shared variance coefficients ranging from 0.57 to 0.75 (Table 2.3). Convergent validity can be judged by looking at both the significance of the factor loadings and the shared variance. The amount of variance shared or captured by a construct should be greater than the amount of measurement error (shared variance >0.50). All the multi-item constructs meet this criterion, each loading (λ) being significantly related to its underlying factor (t-values >15.98) in support of convergent validity. To assess discriminate validity, we performed a series of chi-square difference tests on the factor correlations among all of the constructs (Anderson and Gerbing, 1988). We performed these on each pair of latent variables by constraining the estimated correlation parameter between them to 1.0 and then performing a chi-square difference test on the values obtained for the constrained and unconstrained models (Anderson and Gerbin, 1988). The resulting significant differences in chi-square indicate that the constructs are not perfectly correlated and that discriminant validity is achieved.

Table 2.3. Validity, reliability and internal consistency

Variable	Item	Parameter	Validity, reliability and internal consistency		
			λ*	R^2	A. M.
Top Management Support	MANSUP1	λ^x_{11}	0.82***(f.p.)	0.67	α=0.926 C.R.=0.926 S.V.=0.759
	MANSUP2	λ^x_{12}	0.89***(23.39)	0.80	
	MANSUP3	λ^x_{13}	0.90***(23.41)	0.81	
	MANSUP4	λ^x_{14}	0.87***(23.10)	0.76	
Technological Skills	TECHSK1	λ^y_{11}	0.75***(f.p.)	0.57	α=0.879 C.R.=0.879 S.V.=0.646
	TECHSK2	λ^y_{12}	0.82***(18.01)	0.68	
	TECHSK3	λ^y_{13}	0.82***(18.02)	0.67	
	TECHSK4	λ^y_{14}	0.82***(17.92)	0.67	
Technological Distinctive Competencies	TECCO1	λ^y_{25}	0.73***(f.p.)	0.53	α=0.923 C.R.=0.904 S.V.=0.656
	TECCO2	λ^y_{26}	0.87***(23.95)	0.76	
	TECCO3	λ^y_{27}	0.86***(23.96)	0.74	
	TECCO4	λ^y_{28}	0.75***(22.74)	0.56	
	TECCO5	λ^y_{29}	0.83***(23.67)	0.69	
Organizational Learning	ORLEAR1	λ^y_{310}	0.86***(f.p.)	0.74	α=0.908 C.R.=0.906 S.V.=0.707
	ORLEAR2	λ^y_{311}	0.88***(23.77)	0.77	
	ORLEAR3	λ^y_{312}	0.84***(23.38)	0.71	
	ORLEAR4	λ^y_{313}	0.78***(22.83)	0.61	
Organizational Innovation	INNO1	λ^y_{414}	0.83***(f.p.)	0.69	α=0.915 C.R.=0.916 S.V.=0.647
	INNO2	λ^y_{415}	0.82***(20.54)	0.68	
	INNO3	λ^y_{416}	0.88***(20.98)	0.78	
	INNO4	λ^y_{417}	0.84***(20.67)	0.70	
	INNO5	λ^y_{418}	0.73***(19.55)	0.53	
	INNO6	λ^y_{419}	0.71***(19.16)	0.51	
Organizational Performance	ORPER1	λ^y_{520}	0.65***(f.p.)	0.53	α=0.867 C.R.=0.870 S.V.=0.577
	ORPER2	λ^y_{521}	0.80***(16.86)	0.65	
	ORPER3	λ^y_{522}	0.69***(16.06)	0.51	
	ORPER4	λ^y_{523}	0.87***(16.97)	0.75	
	ORPER5	λ^y_{524}	0.71***(15.98)	0.51	

Note: λ* = Standardized Structural Coefficient; R^2 = Reliability; α = Alpha Cronbach; C. R. = Compound Reliability; S. V. = Shared Variance; f. p. = fixed parameter; A. M. = Adjustment Measurement; $*p < .05$; $** p < .01$; $*** p < .001$(two-tailed).

The overall fit measures, multiple squared correlation coefficients of the variables (R^2s), and signs and significance levels of the path coefficients all indicate that the model fits the data well (χ^2_{340}=713.79, p>.001; χ^2_{ratio}=2.09; NFI=.98; NNFI=.99; GFI=.99, CFI=.99, IFI=.99, PGFI=.83). The hypothesized model was a significantly better fit than the null model (χ^2_{378}=14242.41, p>.001; $\Delta \chi^2_{38}$=13528.62, p>.001). All of the modification indices for the beta pathways between major variables were small, suggesting that adding additional paths would not significantly improve the fit. The residuals of the covariances were also small and centred around zero.

If we look at the standardized parameter estimates (Table 4), the findings show that top management support is closely related and affects technological skills (γ_{11}=.50, p<.001, R^2=.25), as was predicted in Hypothesis 1. The technological distinctive competencies are influenced by top management support (γ_{21}=.67, p<.001) and technological skills (β_{21}=.33, p<.001), supporting Hypotheses 2 and 3, respectively. Furthermore, we have shown an indirect effect (.16, p<.01) of top management support on technological distinctive competencies by technological skills (.50x.33; see, for instance, Bollen [1989] for calculation rules). The global influence of top management support on technological distinctive competencies is thus 0.83 (p<.001). Comparing the magnitudes of these effects indicates that the effect of top management support on technological distinctive competencies is larger than the total effect of technological skills on technological distinctive competencies. Globally, technological distinctive competencies are explained well by the model (R^2=.78).

Organizational learning is directly influenced by top management support (γ_{31}=.41, p<.001). Furthermore, we have shown an indirect effect (.33, p<.01) of top management support on organizational learning by technological distinctive competencies (.67x.40) and technological skills – technological distinctive competencies (.50x.33x.40). The global influence of top management support on organizational learning is thus 0.43 (p<.001), supporting Hypothesis 4. Organizational leaning is also influenced by technological distinctive competencies (β_{32}=.40, p<.001), supporting Hypothesis 5. Comparing the magnitudes of these total effects indicates that the effect of top management support on organizational learning is larger than the effect of technological distinctive competencies on organizational learning. Globally, organizational learning is explained well by the model (R^2=.60).

Organizational innovation is influenced by technological distinctive competencies (β_{42}=.42, p<.001) and organizational learning (β_{43}=.26, p<.001), supporting Hypotheses 6 and 7, respectively. Furthermore, we have shown an indirect effect (.10, p<.01) of technological distinctive competencies on organizational innovation by organizational learning (.40x.26). The global influence of top management support on technological distinctive competencies is thus 0.83 (p<.001). Comparing the magnitudes of these effects indicates that the total effect of technological distinctive competencies on organizational innovation is larger than the total effect of organizational learning on organizational innovation. Globally, organizational innovation is explained well by the model (R^2=.40).

Finally, for organizational performance, we find a significant relationship with technological distinctive competencies (β_{52}=.24, p<.001), organizational learning (β_{53}=.23, p<.01) and organizational innovation (β_{54}=.19, p<.001), supporting Hypotheses 8, 9 and 10, respectively. Furthermore, we have shown an indirect effect (.19, p<.01) of technological distinctive competencies on organizational performance by organizational innovation (.42x.19), organizational learning (.40x.23), and organizational learning – organizational innovation (.40x.26x.19). The global influence of technological distinctive competencies on organizational performance is thus 0.43 (p<.001). There is also an indirect effect (.05, p<.01) of organizational learning on organizational performance by organizational innovation (.26x.19). The global influence of organizational learning on organizational performance is thus 0.28 (p<.001). Comparing the magnitudes of these effects indicates that the effect of technological distinctive competencies on organizational performance is larger than the total effect of organizational learning or innovation on organizational performance. Globally, organizational performance is explained well by the model (R^2=.33). In addition to these effects, we have shown other indirect effects (Table 2.4) of top management support on organizational innovation (.54, p<.001) and performance (.47, p<.001), and of technological skills on organizational learning (.13, p<.01), innovation (.17, p<.001) and performance (.14, p<.001).

Table 2.4. Structural Model Result (Direct, Indirect and Total Effects)

Effect from		To	Direct Effects [a]	*T*	Indirect Effects [a]	*t*	Total Effects [a]	*t*
Top Management Support	→	Technological Skills	0.50***	12.75			0.50***	12.75
Top Management Support	→	Technological Dist. Comp.	0.67***	12.10	0.16***	8.37	0.83***	16.14
Top Management Support	→	Organizational Learning	0.41***	3.46	0.33***	3.69	0.74***	15.68
Top Management Support	→	Organizational Innovation			0.54***	16.06	0.54***	16.06
Top Management Support	→	Organizational Performance			0.47***	14.01	0.47***	14.01
Technological Skills	→	Technological Dist. Comp.	0.33***	7.12			0.33***	7.12
Technological Skills	→	Organizational Learning			0.13**	3.28	0.13**	3.28
Technological Skills	→	Organizational Innovation			0.17***	5.89	0.17***	5.89
Technological Skills	→	Organizational Performance			0.14***	5.56	0.14***	5.56
Technological Dist. Comp.	→	Organizational Learning	0.40***	3.65			0.40***	3.65
Technological Dist. Comp.	→	Organizational Innovation	0.42***	5.80	0.10**	3.24	0.52***	8.39
Technological Dist. Comp.	→	Organizational Performance	0.24***	4.68	0.19***	3.98	0.43***	7.86
Organizational Learning	→	Organizational Innovation	0.26***	3.33			0.26***	3.33
Organizational Learning	→	Organizational Performance	0.23***	3.05	0.05***	2.89	0.28***	3.71
Organizational Innovation	→	Organizational Performance	0.19***	4.68			0.19***	4.68
Goodness of Fit Statistics	χ^2_{340}=713.79 (*P*>0.01) GFI=0.99 AGFI=0.98 ECVI=4.23 AIC=845.79 CAIC=1129.81 NFI=0.98 NNFI=0.99 IFI=0.99 PGFI=0.83 NCP=373.79 RFI=0.98 CFI=0.99 RMSEA=0.074							

Notes: [a] Standardized Structural Coefficients; [†] $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

In testing the theoretical framework, we fit several nested models, each incorporating different assumptions about parameters. Comparisons with reasonable alternative models are recommended as a means of showing that a hypothesized model is the best representation of the data. Comparison is considered to be an important part of assessing model fit (Bollen and Long, 1993). The summary statistics in Table 2.5 indicate that Model 1 was preferred to the others, supporting the inclusion of a model with these relationships among the analyzed constructs. For example, if we compare the theoretical model (Model 1) with a model that does not consider the relationship between technological skills and technological distinctive competencies (Model 4), we can see that the latter has a worse Root Mean Square Error of Approximation (>RMSEA=.006), Expected Cross-Validation Index (>ECVI=.28), Akaike Information Criterion (>AIC=56.41), Consistent Akaike Information Criterion (>CAIC=52.1) and Estimated Non-Centrality Parameter (>NCP=57.41). Hence, results show that technological skills affect technological distinctive competencies and that Model 1 was preferred to Model 4 ($\Delta\chi^2$=58.41, Δdf=1). Likewise, the theoretical model is preferable to other models formulated (Table 5). Length restrictions prevent a detailed discussion of each model and of other models (a full report is available from the authors). In sum, the proposed theoretical model represents (Figure 2.2) the preferred, i.e. the most acceptable and parsimonious, model.

Table 2.5. Model Statistics against Theoretical Model

Model	Description	χ^2	*df*	$\Delta\chi^2$	RMSEA	ECVI	AIC	NCP	CAIC
1	Theoretical	713.79	340		0.074	4.23	845.79	373.79	1129.81
2	W.R. Top Manag. Support→Tech. Dist. Comp.	956.55	341	242.76	0.095	5.43	1086.55	615.55	1366.26
3	W.R. Top Manag. Support→Org. Learning	753.44	341	39.65	0.078	4.42	883.44	412.44	1163.15
4	W.R. Tech. Skills→Tech. Dist. Comp.	772.20	341	58.41	0.080	4.51	902.20	431.20	1181.91
5	W.R. Tech. Dist. Comp.→Org. Learning	731.27	341	17.48	0.076	4.31	861.27	390.27	1140.99
6	W.R. Tech. Dist. Comp.→Org. Innovation	726.51	341	12.72	0.075	4.28	856.51	385.51	1136.23
7	W.R. Tech. Dist. Comp.→Org. Performance	723.54	341	9.75	0.075	4.27	853.54	382.54	1133.25
8	W.R. Org. Learning→Org. Innovation	738.39	341	24.06	0.076	4.34	868.34	397.39	1148.10

Notes: W.R.=Without Relationship; n=201

2.5. Discussion and implications

Taking previous studies into account, this article provides a global model that determines the theoretical and empirical effects of the top management's support of technology on the generation of technological skills, technological distinctive competencies and organizational learning. It also examines the effects that technological distinctive competencies and organizational learning have on organizational performance directly and indirectly through organizational innovation. The results of this analysis offer important theoretical and managerial implications for both researchers and business practitioners.

Along the lines of previous theoretical studies, this paper provides theoretical evidence that top management support of technology positively influences the generation of technological skills, technological distinctive competencies and organizational learning. However, our study goes further and also shows, first, how top management support of technology indirectly affects technological distinctive competencies through the development of technological skills; and, second, how organizational learning improves with the development of technological distinctive competencies generated as a result of top management support of technology. These results reveal the importance of promoting implementation of new technologies in organizations, a well-accepted principle for sustaining or advancing competitive advantages in the marketplace (Kim and Pae, 2007). Some studies argue that firms that utilize the most recent advances in technology face better chances of survival than those that do not (Levitas et al., 2006). Our research shows, however, that firms wishing to achieve this goal must update their technological skills, which can be improved through top management support (Cordero et al., 2004). Such updating in turn affects the generation of technological distinctive competencies (Caldeira and Ward, 2003) and facilitates effective use of technology. Effective use is not possible otherwise, as some technology may be especially foreign and unfamiliar to a firms' technological competency base (Steensma, 1996). Further, generation of these technological distinctive competencies, which form part of the company's knowledge creation system (Leonard-Barton, 1992), fosters organizational learning processes (Andreu and Ciborra, 1996) that provide a foundation for organizations to gain sustainable competitive advantages (Jiménez and Sanz, 2011).

Another theoretical contribution of this study is that technological distinctive competencies and organizational learning affect organizational performance positively, directly and indirectly through organizational innovation. Our research supports the theoretical arguments of previous studies on the positive relationship of technological distinctive competencies (e.g., DeCarolis, 2003; Lokshin et al., 2009), organizational learning (e.g., Carayannis et al., 2006; Garvin, 1993) and organizational innovation (e.g., Aragón et al., 2007; Thornhill, 2006) to organizational performance. However, we also verify that technological distinctive competencies and organizational learning affect organizational performance positively and indirectly through organizational innovation. Organizational innovation is a strategic factor to enable growth and the creation of wealth (Damanpour et al., 2009; Hurley and Hult, 1998). To improve their organizational innovation levels, firms create contexts that facilitate innovation, dedicating resources to this goal and assuming a structure and culture that stimulate the development and implementation of innovations (Senge et al., 1994; Van de Ven, 1986). Organizational innovation becomes essential, because it enables their renewal over time, firms' adaptation and change to meet new market demands (Smith et al., 2005). It also helps organizations to achieve a better response from the environment (García et al., 2007b). This study shows the indirect effect of technological distinctive competencies and organizational learning on performance through organizational innovation to be especially appealing. On the one hand, we find that organizations that foster technological distinctive competencies stimulate the recognition and application of new knowledge in firms, which helps them to create and distribute innovative products or services that consumers will value and that will thus have positive repercussions for organizational performance (Wang et al., 2004). On the other hand, these results show that cultures of learning within organizations facilitate the search for and development of new knowledge, which leads to an increase in organizational innovations that will in turn improve organizational performance (Aragón et al., 2007; Real et al., 2006).

Our research also has implications for business practitioners. First, the presence of top managers who support the implementation of new technologies and encourage a technologically proactive attitude in organizations has become a key factor. This attitude helps firms to adopt technologically advanced stances and to exploit new opportunities that emerge continuously in environments subject to intense technological change (García et al., 2007b).

Second, the acquisition of new technological distinctive competencies can be stimulated through the development of technological skills, which can be encouraged with the support of top management through a new and broader type of training (Swamidass and Nair, 2004). Competency-building is a complex, long-term process that must take place hand-in-hand with a long-term corporate strategy (Miyazaki, 1999). Involving management through the design of the entrepreneurial strategy is thus also a fundamental issue.

Third, organizations that place managers with a predisposition to learning in decisive positions and that promote top management's stimulation of a shared vision (Senge et al., 1994) facilitate the development of organizational learning. When top management supports investments in learning, public talks on learning and the elimination of negative group dynamics that might impede it, organizational learning is fostered within the firm (García et al., 2007b).

2.6. Conclusions

To synthesize and conclude, we should point out that the sources of sustainable competitive advantage in technology firms are based on a set of technological distinctive competencies and other capabilities present in these organizations (García et al., 2007b). Thus, managers should stress the fostering of technological distinctive competencies, organizational learning and organizational innovation, as all of these competencies and strategic capabilities can have positive effects on improving organizational performance (Hurley and Hult, 1998; Real et al., 2006). In this way, organizations will find themselves in a better position to respond to turbulence in the environment and to take advantage of the technological opportunities that are generated continuously. These activities will contribute to improving their competitive position.

2.7. Limitations and future research

The investigation presented here exhibits several limitations that should be considered. First, survey data based on self-reports may be subject to social desirability bias (Podsakoff and Organ, 1986). However, an assurance of anonymity can reduce such bias even when responses are related to sensitive topics (Konrad and Linnehan, 1995). The low risk of social desirability bias in this study was indicated by several managers who commented that it made no sense at all for their companies to go beyond regulatory compliance. In the absence of published data, our investigation follows the methods used in previous studies (e.g., Bueno et al., 2010; Llorens et al., 2004). We thus compared the model obtained to the model in which the objective values for performance available to us were used. We found no significant differences between the two models. Further, the results from the correlation analysis between objective and subjective performance data show close relationships.

Second, although Harman's one-factor test and other method test did not identify common method variance as a problem, it still may have been (Podsakoff and Organ, 1986; Konrad and Linnehan, 1995). Although Spector (2006) has argued it is incorrect to assume that the use of a single method automatically introduces systematic bias, we recommend that future research gather measures of independent and dependent variables from different data sources to minimize the effects of any response bias (Podsakoff et al., 2003).

Third, our data are cross-sectional, making it difficult to examine the evolution of the different variables in our study. This issue is of particular interest, considering the dynamic nature of some of our variables. Although we tested the most plausible directions for the pathways in our model, longitudinal research is needed to assess the direction of the relationship and to detect possible reciprocal processes. We have tried to temper this limitation through attention to theoretical arguments that rationalize the relationships analyzed and integration of temporal considerations into measurement of the variables (Hair et al., 1999). Fourth, futures studies should be based on a larger sample, preferably in more than one country and in other sectors.

Finally, the model only analyzes the relation of top management support and technological skills to organizational performance through technological distinctive competencies, organizational learning and organizational innovation. It should be noted that the variables selected explain an acceptable amount of variance of organizational performance. Other intermediate constructs could be analyzed, such as corporate entrepreneurship or knowledge management (e.g., Nonaka and Takeuchi, 1995). We might also examine other consequences of introducing learning and innovation processes in organizations (e.g., quality improvement, staff satisfaction, improvements in relational capability). The homogeneous geographical context examined here limits the influence of external factors, but future research might well explicitly integrate the influences of external factors (Aragón and Sharma, 2003). More empirical papers supporting (or rejecting) our results in different contexts would be welcomed (especially longitudinal studies).

2.8. Appendix

Top Management Support: Indicate the degree to which you agree or disagree with the following statements about top management support: (1) Top management cultivates technology project champions, (2) Top management ensures adequate funding of technology research and development, (3) Top management restructures work processes to leverage technology opportunities in the organization, (4) Top management facilitates technology transfer throughout the organization.

Technological Skills: Indicate the degree to which you agree or disagree with the following statements about the technological skills. The skills of the people in the organization: (1) Are very superior to closest competitors in hardware and operating systems performance, (2) Are very superior to closest competitors in business applications software performance, (3) Are very superior to closest competitors in communications services efficiency, (4) Are very superior to closest competitors in implementing new acquired technological knowledge and technologies.

Technological Distinctive Competencies: Indicate the degree to which you agree or disagree with the following statements about whether the organization has: (1) Competence to obtain information about the status and progress of science and relevant technologies, (2) Competence to generate advanced technological processes, (3) Competence to assimilate new technologies and useful innovations, (4) Competence to attract and retain qualified scientific-technical staff, (5) Competence to dominate, generate or absorb basic and key business technologies.

Organizational Innovation: The organization has increased significantly: (1) The emphasis on developing new products/services, (2) The rate of introduction of new products/services on the market, (3) Spending on new product/service development activities, (4) The number of products/services added by the organization and already existing on the market, (5) The number of new products/services introduced by the organization for first time on the market, (6) Percentage of revenue generated from new businesses/services that did not exist three years ago.

Organizational Learning: In the last three years: (1)The organization has acquired and shared much new and relevant knowledge that provided competitive advantage, (2) The organization's members have acquired some critical skills that provided competitive advantage, (3) Organizational improvements have been influenced fundamentally by new knowledge entering the organization (knowledge used), (4) The organization is a learning organization.

Organizational Performance: Relative to your main competitors, what is your firm's performance in the last three years in the following areas? (1) Organizational performance measured by return on assets (economic profitability or ROA), (2) Organizational performance measured by return on equity (financial profitability or ROE), (3) Organizational performance measured by return on sales (percentage of profits over billing volume), (4) Organization's market share in its main products and markets, (5) Growth of sales in its main products and markets.

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CAPÍTULO 3:

ORGANIZATIONAL LEARNING AND

NEW BUSINESS VENTURING:

THE MODERATING ROLE OF THE FIRM'S

TECHNOLOGICAL ORIENTATION

Organizational learning and new business venturing: The moderating role of the firm's technological orientation

Abstract

To cope with the dynamism of the environment, companies are increasingly emphasizing their technological orientation as a strategy to enhance their competitiveness. Technology-based firms that distinguish themselves by supporting the latest technological advances, while also fostering learning within the organization, tend to be more able to develop new knowledge and introduce new products and services that enable them to expand their boundaries by creating new businesses. In this context, this study addresses the following research question: how does the firm's technological orientation affect the relation between organizational learning and new business venturing? Based on a sample of 160 European technology-based firms, our findings suggest that the positive relation between organizational learning and new venture creation is stronger in companies that possess a high technological orientation than in firms that do not. The study concludes with a discussion section that suggests several implications and proposes future lines of research.

Keywords

Organizational learning, new business venturing, technological orientation, organizational performance

3.1. Introduction and Study Objectives

In the past decade, technology-based companies like Procter & Gamble, Ericson, and Hewlett-Packard, among many others (Covin and Miles, 2007), have spent billions of dollars developing new ventures (Dushnitsky and Lenox, 2006). Such development highlights the fact that organizations in continuously changing markets and conditions of greater globalization are trying to identify new ways of doing business, developing new technologies and products, and entering new markets in order to succeed (Teng, 2007). In this context, technology-based firms that wish to take advantage of new business opportunities have increased their attention to strategic technological assets and knowledge (Carnabuci and Operti, 2013; Zhou and Wu, 2010) as critical factors for achieving competitive advantages and organizational success (Grant, 1996a; Kostopoulos et al., 2011; Matusik and Heeley, 2005).

Technology-based companies that promote organizational learning—the process that enables organizations to acquire, process, maintain, and exploit new knowledge (Huber, 1991; Lai et al., 2010)—create an organizational climate that facilitates new business venturing (or corporate venturing) (Martín et al., 2013), here defined as the entrepreneurial efforts through which established companies create new businesses, either internal or external (Sharma and Chrisman, 1999; Covin and Miles, 2007). Organizational learning is a key to nurturing technology-based firms with fundamental new knowledge about such areas as markets, competitors, clients, and technological advances. These knowledge flows in turn enhance the company’s ability to create and launch new products and services in the industry, an activity that helps established organizations to extend their current lines of operation by pursuing new businesses

(Ravasi and Turati, 2005). Strategically, established firms pursue entrepreneurship by creating new businesses as a means to increase growth, profitability, and their competitiveness in global markets (Zahra et al., 2006).

Although organizational learning is considered to impact new business venturing decisively (Keil, 2004), it is important to note that additional factors can condition established firms' tendency to create new businesses and expand beyond their current market arenas (Narayanan et al., 2009). In particular, and in the context of technology-based firms, some studies indicate that companies that emphasize their technological orientation—their ability, support, and willingness to acquire a substantial and relevant technological background and to deploy it to develop new products and meet new customer needs (Gatignon and Xuereb, 1997; Kim et al., 2013)—take advantage of the opportunities that technological resources and capabilities provide to enhance venturing activities (Antoncic and Prodan, 2008; García et al., 2013). Hence, this paper addresses the following research question: How does the firm's technological orientation affect the relation between organizational learning and new business venturing?

On the one hand, organizational learning and a technological orientation guarantee that the firm will acquire and develop the knowledge inputs and strategic technological assets required to nurture corporate venturing activities. In fact, entrepreneurial projects such as new business venturing represent learning processes that require contribution from different and complementary resources (i.e., knowledge, technologies) (Ravasi and Turati, 2005). Such processes can be fueled by promoting an active technological orientation. Building a strong technological orientation in the firm is not a simple task, however. It requires effective top management support of new technological advances, development of processes to attract and train the most qualified scientific and technical staff, and commitment to acquiring or generating modern technologies to produce improved products or services in technology-based firms (Bolívar et al., 2012). Such activities may at times create difficulties in integrating new technologies with existing knowledge generated through learning processes, potentially complicating the company's ability to create new business lines or expand existing ones, and thus limiting new business venturing actions (Garrett and Covin, 2013). Conflicting arguments persist in the literature, justifying the need to perform additional analyses in order to provide fuller theoretical and empirical understanding of the phenomenon examined.

Additionally, our study explores the impact that new venture creation can have on organizational performance in technology-based companies, measured in terms of strategic and financial market performance (Martín et al., 2013). New business venturing has been found to be critical to creating wealth and improving organizational performance by enabling firms to renew and expand their operations (Burgelman and Valikangas, 2005; Narayanan et al., 2009). Previous research also documents, however, that corporate venturing is a complex process that can take years to pay off (Zahra et al., 2006). We contribute to the existing literature by increasing understanding of the relation between new business creation and firm performance, a topic of crucial importance for technological firms.

To answer our research question, we performed an empirical analysis using a sample of 160 European technology-based firms. Our findings indicate that the positive effect of organizational learning on new business venturing becomes stronger in technology-based firms with a high technological orientation than in firms that lack this orientation. In other words, our study shows that combining the knowledge developed through learning activities with the technological strategic assets that a strong technological orientation provides increases the firm's tendency to engage in new business venturing activities. In addition, our results confirm the positive effect that creating new businesses has on organizational performance (Garvin, 2004; Narayanan et al., 2009).

This research contributes to the existing literature on technology strategy (Kim et al., 2013; Xu et al., 2013) by showing how a strong technological orientation and learning help established firms to grow by developing new businesses. We also develop a deeper understanding of the connection between technology strategy and entrepreneurial actions (Antoncic and Prodan, 2008), based on venturing activities in the context of technology-based firms. Finally, the study adds to the Resource-Based View of the firm (Barney, 2001; Wernerfelt, 1984) by explaining how the knowledge generated through learning processes, combined with strategic technological resources and developed through the firm's technological orientation, contributes to promoting organizational competitive advantages.

The article is structured as follows. Section 2 draws on prior literature to develop the study hypotheses. Section 3 presents the data and the methodology used in this research. Section 4 discusses the results obtained. Finally, Section 5 presents the conclusions of this study, its theoretical and practical implications, limitations, and various lines for future research.

3.2. Hypotheses

3.2.1. The influence of organizational learning on new venture creation

Organizational learning is a process related to the development of new knowledge (Huber, 1991). Given that a wide set of knowledge-based resources can be used to identify and exploit new entrepreneurial opportunities (Bojica and Fuentes, 2011), this process can have important consequences for corporate venturing in technology-based firms (e.g., the Information and Telecommunication sector). Indeed, new business venturing can be viewed as the outcome of learning processes where companies learn to act and operate in a new business domain and develop new capabilities or reconfigure existing ones to do so (Keil, 2004). Learning activities can encourage firms to pursue innovations to broaden their business domain in new domestic or international markets (Zahra et al., 1999).

New business venturing activities are critical to establishing innovation as part of the corporate culture, developing profitable new products, services, and markets, and discovering new opportunities before competitors do (Block and MacMillan, 1993). Not acquiring, processing, and developing general knowledge about the market, how to address customers' problems, and how to satisfy client's needs, however, reduces the organization's chances of benefiting from the exploitation of potential new businesses (Bojica and Fuentes, 2011; Shane, 2000). Under such circumstances, firms increase their reliance on internal and external knowledge sources, which can be renewed through learning processes, because these sources open a window through which to access new ideas, develop innovations in current and new markets, and renew the firm's operations. They can also be determinants to foster new venture creation (Narayanan et al., 2009). For example, the firm may generate knowledge about how to enter a particular market, what business model is the most appropriate in that market, how to test assumptions about markets, or how to obtain relevant information regarding emerging markets, thereby increasing the corporate venture capability that results from learning processes (Keil, 2004).

Despite the foregoing arguments, knowledge recently developed must be transformed and converted into refined ideas to provide a basis for recognizing potential opportunities (Zahra, 2008), which may in turn affect how organizations broaden their business lines in current or new industries through corporate venturing. Learning processes may also have limitations, since learning must at times address confusing experiences (Levinthal, 1993). Most significantly, irrelevant, unrelated, inappropriate, or incorrect knowledge can flow within an organization (Garrett and Covin, 2013), creating inefficiencies and making it difficult to integrate knowledge about customers, markets or related to potential profitable new business arenas to exploit through corporate venturing.

In spite of this last line of research, organizational learning is critical in enabling technology-based industries such as Information Technology to come up with new and innovative products, adapt to environments and customers' needs, and benefit from emergent market opportunities by expanding the firm's business portfolio (Bingham and Davis, 2012). As Zahra states (2008), deep learning—learning related to the extent up to which the company masters the knowledge internally developed or externally acquired—tends to enhance the company's ability to exploit new knowledge combinations, boosting entrepreneurial activities that refine current business lines. In addition, the diversity of knowledge bases available (i.e., breadth of learning) favors entering different business fields by promoting entrepreneurial activities. As Van der Steen et al. (2013) illustrate based on case studies that formed part of Philips' corporate venturing activities, the generation of knowledge capabilities (i.e. explorative, exploitative, and transformative learning) is critical to facilitating the birth and growth of technology-based corporate ventures. Based on these premises, we posit that learning processes enhance corporate venturing in technology-based firms (Huang, 2009; Keil, 2004; Zahra, 2012). Thus:

Hypothesis 1: High levels of organizational learning will increase new business venturing in technology-based firms.

3.2.2. The moderating effect of the firm's technological orientation on the relation between organizational learning and new business venturing

Technology can affect the firm's entrepreneurial activities, and the technology context of a firm is a critical factor that triggers corporate venturing activity (Narayanan et al., 2009). Technology firms that improve their knowledge of current and potential markets while also enhancing their technological knowledge bases will be more likely to discover new opportunities and exploit them effectively (Bojica and Fuentes, 2011; Wiklund and Shepherd, 2009), thereby increasing the company's tendency to engage in new business venturing as a critical part of corporate entrepreneurship activities (García et al., 2013). For instance, Covin and Miles (2007) indicate that investing in R&D (a key technological resource) allows technology-based firms like Siemens Mobile Acceleration to evaluate, absorb, and leverage acquired knowledge and technologies;

strategies that greatly contributed to Siemens' success in exploiting corporate venturing for strategic purposes.

As noted earlier, organizational learning enhances proactivity in pursuing entrepreneurial activities, allowing the firm to enjoy pioneering advantages by establishing industry's standards (Zahra, 2008). Companies that also emphasize their technological orientation benefit from ability to integrate knowledge to generate new ideas faster, possess a larger technological assets portfolio, and use the latest technologies for new product development (Kim et al., 2013; Li, 2005). Consequently, they develop stronger technological capabilities and competences that result in improved understanding of emerging opportunities for growth based on promising new trends to stimulate corporate venturing activities (García et al., 2013). These companies also achieve higher absorptive capacity levels (Xu et al., 2013), which positively affect their likelihood of investing in new ventures in industries with high technological ferment (Dushnitsky and Lenox, 2005).

Technologically-oriented firms can use their technical knowledge to generate a new technical solution to meet and satisfy new needs of the users with the potential for achieving greater competitive advantage (Gatignon and Xuereb, 1997). For this reason, technology-based companies, with a sufficient and updated knowledge base developed through organizational learning and reinforced through a strategic technological orientation (for example, increasing R&D projects), tend to increase their willingness to explore unserved markets. This willingness could be achieved through new business venturing activities, since firms have a greater ability to draw on different knowledge sources to exploit new business opportunities (Kim et al., 2013; Zahra, 2012).

Moreover, technology-based companies with a considerable technological background, such as pharmaceuticals, excel in applying new technologies to enhance product design and quality (Xu et al., 2013). Such improvements can affect new business venturing as a phenomenon based on a new product, development of a new market, or commercialization of a new technology (Block and MacMillan, 1993). The combination of the knowledge about potential business fields that results from learning processes, together with an increased capacity for satisfying customers needs by offering improved products and services, provides substantial opportunities for firms to create a new business domain within the existing organization by redefining current products and/or by developing new markets (Antoncic and Hisrich, 2001).

Invention as a result of a strong technological orientation that supports learning and innovation does not always translate into new business venturing, however. Covin and Miles (2007) argue that dozens of high-profile technology firms, such as Hewlett Packard and Lucent have remarkable proficiency in new product development but poor track records in new business development. Although commitment to learning and technological support lead to proactive scanning, greater knowledge acquisition, and improved techniques to develop new products, reality shows that some outcomes may be novel but not necessarily meaningful (Kim et al., 2013). Additional problems emerge from the fact that technologies supported by a strategic technological orientation may differ in their relatedness to the company's knowledge base (Zahra, 2008), an issue that can hinder entrepreneurial actions within established companies.

Following Zahra et al. (2006; p. 541), however, our theory suggests that "in order to create new businesses, established companies must combine existing (or new) resources in new ways. These recombinations can open new paths for building new skills, renewing operations, or venturing into market arenas within existing or new industries." Enhancing the firm's technological initiatives and resources, as well as organizational learning in technology-based industries such as high-technology services (e.g., Research and Development) and high-technology manufacturing (e.g., the chemical industry, aerospace construction, computer science equipment), has a complementary effect that boosts established firms' corporate venturing activities (Martín et al., 2013). We thus argue that technology-based firms that promote organizational learning and support a strategic technological orientation will benefit from improved ability to integrate diverse and complementary knowledge flows about technologies, customers, and markets to strengthen the firm's willingness to engage in new business venturing. Thus:

Hypothesis 2: The positive relation between organizational learning and new business venturing in technology-based firms will become stronger when the firm's technological orientation increases.

3.2.3. The influence of new business venturing on organizational performance

Creating new businesses has been recognized as a key factor in improving firm growth and profitability (Thornhill and Amit, 2010; Zahra, 2006). Technology firms get involved in venturing primarily for three reasons: to become more innovative and to make the overall company more entrepreneurial and readier to accept change; to appropriate more value from existing organizational competencies; or to expand and broaden the firm's operations in strategic areas that could potentially offer quick financial returns (Kuratko et al., 2009; Miles and Covin, 2002). Covin and Miles (2007), for example, show that technology-based firms like Intel hope by venturing to gain first-mover advantages in the technology space, thereby making competitors dependent on Intel architecture and in turn providing a source of competitiveness and increased streams of revenue for the firm. As this example shows, corporate venturing is an important way to generate wealth in established organizations by allowing firms to renew their operations and develop capabilities required to compete in new markets (Narayanan et al., 2009).

New business venturing activities can result from a company's wish to commercialize in different business lines innovative products and services that can capture unique businesses opportunities with the potential to generate better economic performance (Ireland et al., 2001; Keil et al., 2009). In competitive environments, firms rely on corporate venturing as a way to increase productivity, sales, and profits (Block and MacMillan, 1993; Sharma and Chrisman, 1999). Venturing constitutes an important and effective mechanism for mainstream corporations that are willing to take part in technology development and market creation processes but hesitant to risk the company's reputation on innovations that could be disruptive for their existing brand, supply chain partners, business units, and traditional and profitable relationships with existing customers (Darroch et al., 2005). For this reason, technology-based companies learn to diversify and enter new countries and different product markets to capture economies of scale and scope (Binghan and Davis, 2012) to obtain financial benefits. Organizations that innovate and pioneer in the creation and introduction of new products or technologies through new businesses usually achieve better financial performance because pioneers can target premium market segments and establish their products as the industry's standard. Such advantages help companies to achieve and sustain superior market share and improve profitability (Zahra and Covin, 1995).

Many firms that engage in corporate venturing never achieve positive results, however. Procter & Gamble, for example, made important investments in strategically irrelevant ventures that not only neglected its core and mainstream businesses but caused financial and reputational damage to the company (Covin and Miles, 2007). The development of new businesses within established companies is both costly in terms of money and time and quite complex, as it involves various formal and informal activities in different organizational levels (Garvin, 2004; Zahra, 2006). Creating a new venture is thus a process that faces significant technical, organizational, and political uncertainties (Zahra, 2006) and that may therefore take several years to pay off (Van de Ven et al., 2000). Companies may have to invest large amounts of money before the new business generates positive cash flow or income (Teng, 2007) that affects the firm overall performance.

Although some counterarguments persist, we conclude that the development of new businesses provides an orientation toward growth and new opportunities that create revenue streams and improve organizational performance (Narayanan et al., 2009; Teng, 2007). In other words, when undertaken strategically, new business venturing in technology companies can be critical to achieving superior corporate performance (Covin and Miles, 2007; Keil, 2009). Thus:

Hypothesis 3: New business venturing in technology-based firms will increase organizational performance.

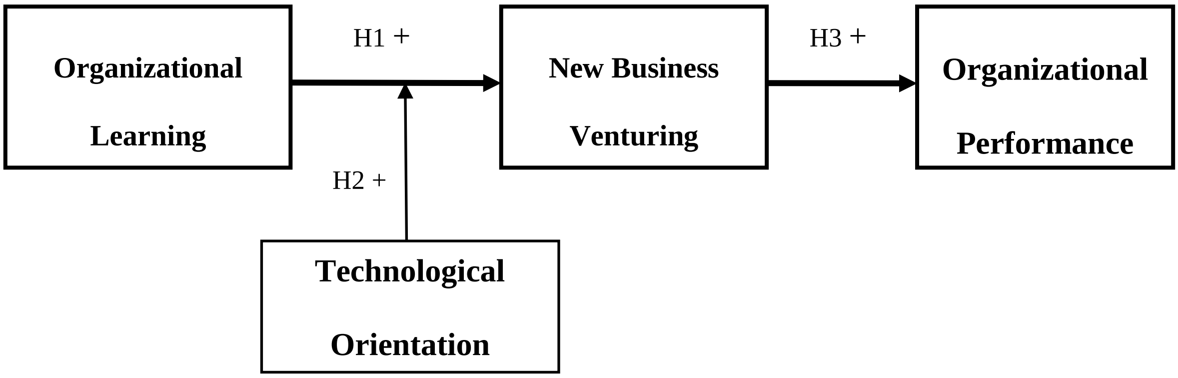


Figure 3.1. Proposed model

3.3. Methodology

This section presents the research methodology used in this study. We first describe the sample used and then discuss how each of the variables included in the study is operationalized. Finally, we present the empirical analysis.

3.3.1. Sample and Procedure

The population for this study consists of European technology-based firms. Technology has changed the economic structure of businesses and generated synergies in business practices. As previous studies suggest, it is advisable to perform analyses within the framework of the EU countries (Verdú et al., 2006) and sectors with a significant technological component to assess the impact of technology in modern economies (García et al., 2013).

The strategic nature of the survey's content requires the participation of CEOs as main informants, because their experience, understanding, and field of action encompass the organization as a whole. CEOs are powerful actors in firms and make important decisions on strategic choices such as new business venturing, organizational learning processes, and resource allocations to technology. They influence the behaviors supported in the organization as well as the actions carried out to achieve them (Baer and Frese, 2003; Westphal and Fredickson, 2001). A list of the CEOs of the organizations was prepared with the help of partial funding from the Spanish Ministry of Science and Research and the Local Government of Economy, Innovation, and Science of Andalusia's Regional Government. After interviews with experts in these strategic areas, we developed a structured questionnaire and sent it to CEOs.

We used the Amadeus (2009) database. The population was divided into ten strata (one for each EU country selected), through stratified random sampling by country. Through systematic sampling in each stratum we then obtained 16 firms for each target country in the study (see Table 3.1). The response rate obtained was 17.7%. An analysis of firm characteristics (number of employees, return on equity, return on sales, return on assets) revealed no significant differences between the responding and non-responding firms (Armstrong and Overton, 1977). Since all measures were collected with the same survey instrument, the possibility of common method bias exists. The authors were aware of this possibility and used several procedures to determine whether common method bias threatened the interpretation of the results. First, Podsakoff et al. (2003) provide guidance to reduce common source bias in this regard, stressing two key goals: a) to ensure anonymity in survey administration; and b) to improve items used to measure constructs. Our study followed both recommendations. By clearly communicating study goals and assuring respondents of the survey's anonymity, the investigation meets a key recommendation of Podsakoff et al. (2003), that well-tested and validated scales reduce item ambiguity. In measuring study constructs, the research also relies on previously tested scales. Finally, the research randomized the order of presentation of the survey items across the subjects. Together, these steps minimize common method bias (Pandey et al., 2008). Second, the investigation tested for the possibility of common method bias using Harman's one-factor test (Podsakoff and Organ, 1986). The rationale for the first test was that, if common method bias poses a serious threat, a single latent factor would account for all manifest variables or one general factor would account for most of the covariance among the measurements. In this investigation, the factor model obtained using principal components analysis yielded eight factors with eigen-values greater than 1.0, which accounted for 64% of the total variance. A substantial amount of method variance does not appear to be present, since several factors – not just one single factor – were identified, and because the first factor did not account for the majority of the variance (Podsakoff and Organ, 1986).

3.3.2. Measures

Organizational Learning. We used a Likert 7-point scale (*1 "totally disagree", 7 "totally agree"*) of four items developed by Bolívar et al. (2012) to measure organizational learning (Appendix). A confirmatory factor analysis was performed to validate the scale (χ^2_2=0.282; GFI=0.99; CFI=1; NFI=0.99). The scale was one-dimensional and showed adequate reliability (Cronbach's alpha α=0.787).

Table 3.1. Technical details of the research

Sectors	Technology-based firms
Geographical location	Europe (Austria, Belgium, Denmark, France, Germany, Italy, Poland, Spain, the Netherlands, United Kingdom)
Methodology	Structured questionnaire
Universe of population	5441 firms
Sample (response) size	160 firms (17.7%)
Sample error	7.7%
Confidence level	95%, *p-q*=0.50; *Z*=1.96
Period of data collection	From May 2010 to September 2010

Technological orientation. We used a five-item Likert 7-point scale (*1 "totally disagree", 7 "totally agree")* based on the studies of Gatignon and Xuereb (1997) and Kim et al. (2013) to measure the firm's technological orientation. These items were duly adapted to the present study (Appendix). We developed a confirmatory factor analysis to validate the scale for technological orientation (χ^2_5=25.1; GFI=0.99; CFI=0.93; NFI=0.91) and confirmed that the scale was one-dimensional and reliable (α=0.819).

New business venturing. We used four items developed by Zahra (1993) to measure new business venturing. These items were duly adapted to the present study (Appendix). We developed a confirmatory factor analysis to validate the scale for new business creation ($\chi^2_{2=}$2.609; GFI= 0.99; CFI=0.99; NFI=0.98) and showed that the scale was one-dimensional and had adequate validity and reliability (α=0.692). Again, a 7-point Likert scale (1 "*totally disagree"*, 7 "*totally agree"*) allowed managers to express agreement or disagreement.

Organizational Performance. We used five items developed by Martín et al. (2013) to measure organizational performance (Appendix). We developed a confirmatory factor analysis to validate the scale (χ^2_{5}=23.1; GFI= 0.95; CFI=0.92; NFI=0.91) and showed that the scale was one-dimensional and had adequate validity and reliability (α=0.782). A 7-point Likert scale (1 *"Much worse than my competitors,"* 7 *"Much better than my competitors"*) allowed managers to express their performance in comparison to their more direct competitors, as recent studies recommend (Bolívar et al., 2013). Our study analyzed the correlation between these subjective data and objective data on organizational performance when provided by databases, and the correlation was high and significant. Both measures are valid when calculating a firm's performance if there is a high correlation (e.g., Homburg et al., 1999; Martín et al., 2013).

Control variables. Our study analyzed some control variables that could affect the results of our analyses. Based on prior literature, we controlled for firm size, firm proactiveness, industry dynamism, and country entrepreneurship rate. To measure firm size, we used the log of the firm's total number of employees (Shinkle et al., 2013). Firm proactiveness—the extent to which an organization is aggressive in pursuing opportunities before competitors do (Antoncic and Hisrich, 2001)—was captured using four items on a 7-point Likert scale (1 "*very little*," 7 "*too much*"). This scale gathered information on how often the firm is the first business to introduce new products/services, how high the inclination to pursue high-risk projects is, how frequent bold wide-ranging acts are seen as necessary, and how often, under uncertain conditions, the company pursues an aggressive posture in order to maximize the probability of exploiting potential opportunities. Controlling for proactiveness is important because the extent to which firms are willing to lead rather than follow usually has a positive effect on the firm's engagement in entrepreneurial activities (García et al., 2013). Additionally, industry dynamism was measured using two items developed by Tan and Litschert (1994). These items assessed the number of factors (such as competitors, customers, suppliers, technology, regulation) to deal with and how dramatic environmental changes were (1 "*very little*," 7 "*too many/much*"). Industry dynamism was used as a control variable because dynamic environments encourage new business development (Zahra, 1993). Lastly, we included a dummy variable to control for countries with high vs. low entrepreneurship rates within the European Union, as the former are expected to have greater rates of new venturing activities than the latter. These data were extracted from the "Entrepreneurship Survey of the EU25"[1] report. We coded the variable as 1 = high entrepreneurship rate in the country (above the EU mean), 0=low entrepreneurship rate (below the EU mean).

3.4. Analysis and results

Table 3.2 presents the descriptive statistics and the correlation matrix for the study variables. The data show a positive and significant correlation among organizational learning, technological orientation, and new business venturing. All control variables (firm size, firm proactiveness, and industry dynamism) are positively and significantly related to new business venturing except country entrepreneurship rate. In addition, the results reported confirm a positive and significant correlation among new business venturing, firm size, firm proactiveness, and organizational performance. Overall, these correlations follow our main theoretical expectations. Since

[1] http://ec.europa.eu/enterprise/policies/sme/files/survey/static2008/portugal_static_en.pdf

none of the correlations was especially high, multicollinearity may not be a problem in this research. To confirm this extreme, we computed the Variance Inflation Factors (VIFs) to check for severity of multicollinearity. Given that none of the VIF scores exceeded the acceptable threshold of five or ten (all ranged from 1.046 to 1.704), problems of multicollinearity were ruled out (O'Brien, 2007).

Table 3.2. Descriptive statistics and correlations

	Mean	S.D.	1	2	3	4	5	6	7	8
1. Size_ log	4.16	2.53	1	,209**	,182*	,076	,255**	,080	,194*	,205**
2. Proactivity	4.56	1.37	,209**	1	,026	,268**	,464**	,251**	,435**	,313**
3. Contry entrepreneurship rate	0.20	0.40	,182*	,026	1	-,088	,163*	-,063	,121	,034
4. Dynamism	5.17	1.42	,076	,268**	-,088	1	,197*	,234**	,192*	,107
5. Technological Orientation	5.25	1.14	,255**	,464**	,163*	,197*	1	,461**	,465**	,386**
6. Organizational Learning	5.53	1.12	,080	,251**	-,063	,234**	,461**	1	,341**	,464**
7. New Business Venturing	4.65	1.41	,194*	,435**	,121	,192*	,465**	,341**	1	,286**
8. Organizational Performance	5.89	1.42	,205**	,313**	,034	,107	,386**	,464**	,286**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

c. Listwise N=160

To test Hypotheses H1 and H2, we used moderated hierarchical regression analysis (Table 3.3). In the first step, the dependent variable (new business venturing) was regressed on all the control variables (Model 1). Subsequently, organizational learning and technological orientation were entered in the independent model (Model 2). Eventually, we included the interaction term in the analysis (Model 3). The independent and moderator variables were mean centered before creating the interaction term in order to avoid problems of multicollinearity (Cohen et al., 2003).

The results of the moderated hierarchical regression analyses are reported in Table 3.3. Model 1 shows that firm proactiveness was the only control variable positively and significantly related to new business venturing ($p<0.001$). As expected, proactive companies, which are inclined to taking risks and are aggressive in pursuing opportunities (Antoncic and Hisrich, 2001), engage in more new venture creation activities. This model, which includes only the control variables, explains 19.6% of the variance in new business venturing.

The data from Model 2 indicate a positive and statistically significant effect of organizational learning on new business venturing ($\beta=0.197$, $p<0.05$). Thus, Hypothesis 1 is supported, as it states that high levels of organizational learning will increase new business venturing in established firms. Further, Model 2 increases the model's explained variance to 27.8% and improves the model's fit compared to Model 1 ($\Delta R^2=0.089$).

In Model 3, the moderating effect of technological orientation on the relation between organizational learning and new business venturing was tested by introducing the interaction term between organizational learning and technological orientation. Hypothesis 2 indicated that the positive relation between organizational learning and new business venturing in established companies strengthens when the firm's technological orientation increased. As the results of Model 3 show, the parameter estimate for this interaction term is positive and significant ($\beta=0.136$, $p<0.05$), supporting Hypothesis 2. Again, the model's fit improves ($\Delta R^2=0.024$).

Table 3.3. Hierarchical regression analysis results for New Business Venturing

Variables	Model 1	Model 2	Model 3
Constant	-0.073	-0.057	-0.151
	(0.112)	(0.107)	(0.113)
Size	0.048	0.027	0.012
	(0.041)	(0.040)	(0.040)
Proactiveness	0.401***	0.269***	0.289***
	(0.077)	(0.080)	(0.080)
Dynamism	0.89	0.041	0.021
	(0.074)	(0.071)	(0.070)
Country high entrepreneurship rate	0.363	0.283	0.354
	(0.256)	(0.247)	(0.246)
Organizational Learning		0.197*	0.243*
		(0.097)	(0.098)
Technological orientation		0.293**	0.344**
		(0.106)	(0.107)
Organizational Learning * Technological orientation			0.136*
			(0.058)
R^2	0.216	0.305	0.330
Adjusted R^2	0.196	0.278	0.299
Change in R^2		0.089	0.024
F	10.703	11.209	10.675

†*p* < 0.10. * *p* <0.05. ** *p* <0 .01. *** *p* < 0.001. N= 160.
Coefficient estimates (ß) and standard errors (in parentheses) are reported.

Finally, Hypothesis 4 was tested using hierarchical regression analysis. The results are presented in Table 3.4. Model 1 suggests that, of the control variables, only firm proactiveness and size have a significant (and positive) effect on organizational performance. As Model 2 shows, new business venturing is positively and significantly associated with organizational performance (β=0.170, p<0.05). This result is consistent with Hypothesis 4, which suggests that corporate venturing in established firms leads to an increase in organizational performance. Thus, Hypothesis 3 is also supported.

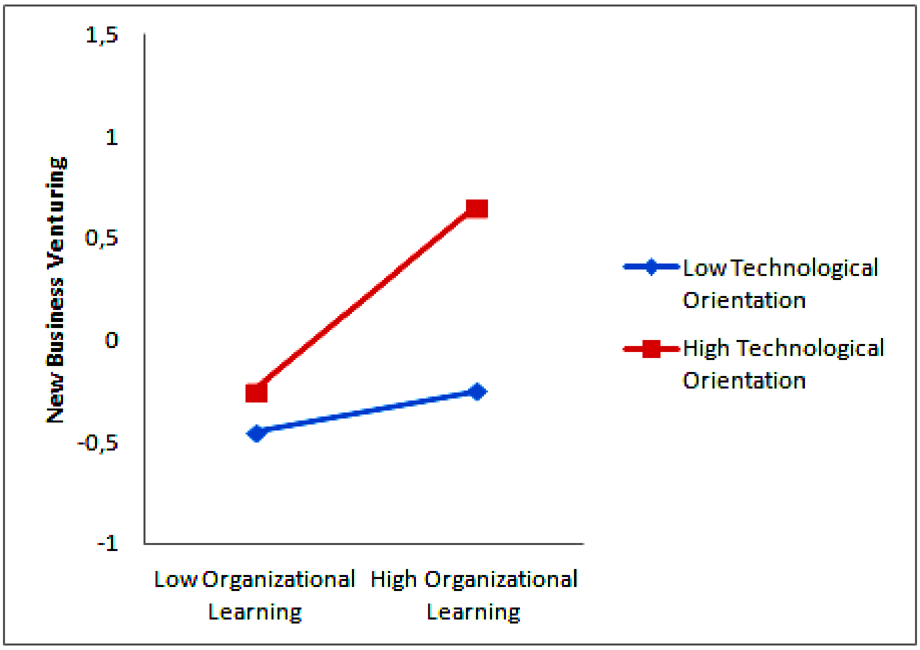
Table 3.4. Hierarchical regression analysis results for Organizational Performance

Variables	Model 1	Model 2
Constant	-0.001	0.011
	(0.119)	(0.118)
Size	0.081 †	0.073†
	(0.044)	(0.044)
Proactiveness	0.285***	0.217*
	(0.082)	(0.088)
Dynamism	0.021	0.006
	(0.078)	(0.078)
Country high entrepreneurship rate	0.006	-0.055
	(0.271)	(0.271)
New Business Venturing		0.170*
		(0.084)
R^2	0.119	0.141
Adjusted R^2	0.096	0.114
Change in R^2		0.023
F	5.225	5.075

† *p* < 0.10. * *p* <0.05. ** *p* <0 .01. *** *p* < 0.001. N= 160.
Coefficient estimates (ß) and standard errors (in parentheses) are reported.

To show the interaction effect, Figure 2 plots the effect of organizational learning on new business venturing at low and high values of the moderating variable, that is, the firm's technological orientation. This figure indicates that new business venturing increases with increases in organizational learning, and that the effect is stronger when the firm has a high technological orientation. The introduction of this moderating effect on the relationship between organizational learning and new business venturing thus strengthens the impact of organizational learning on new business venturing.

Figure 3.2. The interaction effect of Technological orientation on the relation between Organizational Learning and New Business Venturing



3.5. Discussion and conclusions

Past literature indicates that firms focus on technology as a way to increase the company's knowledge base, expand their operations in current and potential new markets, and face competitive pressures in dynamic environments (Antoncic and Prodan, 2008; Linton and Walsh, 2013). In the context of technology-based firms, this study addresses the following research question: Does the firm's technological orientation affect the relation between organizational learning and new business venturing? After verifying that organizational learning processes improve technology-based companies' tendency to engage in corporate venturing activities, our results reveal that firms that also develop a strategic technological orientation present higher levels of new business venturing activities than firms that do not emphasize such orientation. It follows from these results that corporate venturing in technology-based firms is critical to enhancing organizational performance because it establishes a culture of innovation and strategic renewal. In what follows, we discuss the theoretical and practical implications of these findings. Some limitations are also presented.

3.5.1. Implications for theory

This study adds to the technology strategy literature that analyzes the consequences of implementing a technological orientation in the firm level (Kim et al., 2013; Gatignon and Xuereb, 1997; Yu et al., 2013). In particular, our findings contribute to existing literature that highlights the key role technology plays in enhancing entrepreneurial activities in technology-based firms (Bojica and Fuentes, 2011; García et al., 2013). As the firm's technological orientation affects how companies create, exploit, and share knowledge within organizations, the interaction with organizational learning processes underway in firms can help us understand why some companies are more active in new business venturing activities than others. Further, whereas previous research tends to focus on the concept of corporate entrepreneurship as a whole (Antoncic and Prodan, 2008; Simsek and Heavey, 2011), our study centers on one of its dimensions, new business venturing, to measure these entrepreneurial activities. We thus extend the current literature on corporate venturing by explaining how the interaction of learning and technology can increase the firm's likelihood of expanding its current operations into new business lines.

As reported in Hypothesis 1, our study corroborates and provides theoretical and empirical evidence for the conclusion that organizational learning positively affects new business venturing in technology-based firms (Keil, 2004; Zahra, 2008). This conclusion addresses previous assertions of the need to carry out theoretically grounded empirical studies to determine how companies build their ability to develop corporate venturing through learning (Narayanan et al., 2009). The generation of new knowledge re-creates firms through non-stop renewal processes (Nonaka, 2007), and the exploitation of knowledge enables the development of new products and services (Kostopoulos et al., 2011). Thus, learning processes provide a fertile setting in which for firms to look for promising new ideas, satisfy new market needs, and consider undertaking new business activities, activities that form the basis of corporate venturing (Block and MacMillan, 1993). Further, consistent with Hypothesis 2, we have shown that the positive relation between organizational learning and new business venturing becomes stronger when companies develop a strategic technological orientation. Learning boosts knowledge creation and exploitation (Huber, 1991), and the firm's technological orientation is a key intangible asset that fuels companies with the technology resources required to be open to new ideas and develop advanced products (Li, 2005). As noted earlier, we have shown that knowledge development processes and the company's technologies complement each other and open a window for enhancing the discovery and creation of opportunities, as well as venturing in different territories, in new arenas, or across fields (Zahra, 2008).

This research also sheds light on the relation between new business venturing and organizational performance. Consistent with Hypothesis 3, our investigation suggests that technology-based companies that promote the development of new businesses within established organizations achieve higher financial and market performance. Although new business venturing can be a complex and costly process (Garvin, 2004), it is still necessary to improve firm performance. If they do not enter new businesses, technology-based companies may miss important entrepreneurial opportunities. Overall, this study highlights that corporate venturing is critical for firm profitability (Covin and Miles, 2007; Keil, 2009).

Last but not least, this study adds to the Resource-Based View of the firm (Barney, 2001; Wernerfelt, 1984). It explains how a firm's ability to manage its knowledge base, developed through learning processes in combination with a strategic technological orientation, contributes to the firm’s efficacy in gaining favorable competitive advantage (Kim et al., 2013).

3.5.2. Implications for practice

Corporate venturing, or the process of developing new businesses within existing organizations, is critical to strategic renewal and firm performance. Yet, debate persists on how to facilitate new business venturing in existing companies (Burgers et al., 2009). This study suggests that technology-based companies that aim to penetrate new markets or expand their current business lines through venturing activities can achieve this goal by promoting organizational learning and pursuing a strong technological orientation.

As noted earlier, organizational learning promotes entrepreneurial activities that allow firms to create new businesses, as well as innovate and renew their operations (Zahra, 2012). Learning through hiring new employees or transferring employees with relevant experience can have a positive effect on corporate venturing capability, as such practices increase the knowledge building and sharing at faster rates (Keil et al., 2004). Further, companies aimed at enhancing venturing by increasing learning capabilities may consider creating cross-functional teams or liaison roles and establishing knowledge management systems as mechanisms to encourage the exchange and creation of knowledge throughout the organization (Schilling and Fang, 2013), a critical input to boost new business venturing (Huang, 2009).

To complement learning processes and achieve an even stronger ability to create new business, firms should develop a strategic technological orientation. Doing so requires a committed top management team that fosters a technologically proactive attitude, identifies potential technological projects, and ensures sufficient funds for R&D and new technology implementation (Bolívar et al., 2012). The role of top managers thus becomes critical to boosting the development of capabilities that seek to implement first-mover strategies (Srivastava and Lee, 2005), thereby enhancing entrepreneurial activities such as new business venturing.

Executives must recognize the importance of championing promising ideas for corporate venturing in order to improve financial performance (Zahra, 1993). To this end, senior managers should insist that everyone pursue new business development within the organization (Block and MacMillan, 1993). As Garvin (2004) suggests, corporate culture influences business creation decisively, and corporate leaders are encouraged to explore diverse perspectives to promote entrepreneurship.

3.5.3. Limitations and future research lines

Interpreting the results of this research requires taking into account its limitations. First, because our analyses are cross-sectional, longitudinal studies should be performed to examine how the study variables and their relations unfold over time. This long-term approach merits special attention. Along the lines of previous research, our study shows a positive relation between organizational learning and corporate venturing (Keil, 2004; Huang, 2009). Technology-based firms may also undertake new venturing activities to augment the search for new knowledge, and such activities may help incumbent firms to learn by entering new markets (Narayanan et al., 2009). Since this kind of entrepreneurial activity can create significant opportunities for organizational learning (Zahra, 1999), longitudinal studies to explore additional causality issues should be developed.

Second, the absence of objective measures is a limitation. Future studies based on objective data would be interesting. The anonymity of our research does play an important role in increasing the value of these subjective measures and reducing social desirability bias for responses on sensitive topics. External validation of some variables (e.g., organizational performance) from the archival data of a subset of respondents (no significant mean differences between these two measures were found) also increases confidence in self-reports and reduces the risk of common method variance (Konrad and Linnehan, 1995). Third, although Harman's one-factor test showed that common method variance was not a problem, future research should collect measures of independent and dependent variables from diverse data sources to reduce the influence of any response bias (Podsakoff et al., 2003).

Another potential limitation of this paper involves the external validity of our results and thus the possibility of generalizing our conclusions. As only European technology-based firms were analyzed, additional research in different settings (i.e. countries) and using larger samples would be useful to validate and extend our empirical results.

In addition, the model only analyzes how the interaction of learning and a strategic technological orientation affect new business venturing in technology-based firms, while also evaluating the impact the latter has on firm performance. Future research that focuses specifically on corporate venturing should distinguish between internal and external corporate venturing activities (Sharma and Chrisman, 1999) to explore whether the interaction of learning and the company's technological orientation affects them in the same way or not.

Finally, corporate venturing is a major, but not the only dimension, of corporate entrepreneurship activities (Zahra, 1993). Future studies could explore other dimensions of corporate entrepreneurship, such as the firm's self-renewal, innovation, and proactiveness (Antoncic and Hisrich, 2001). Such studies would enable deeper understanding of how the company's technological orientation moderates the relation between organizational learning and every single component of corporate entrepreneurship, and the specific implications of each component for firm performance in technology-based firms.

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3.6. Appendix

1. Organizational learning (1 "Totally disagree"; 7 "Totally agree").

1.1. The organization has acquired and used a lot of new and important knowledge.

1.2. The members of the organization have learned or have acquired some critical abilities or capabilities.

1.3. The organization has improved as the result of the new knowledge acquired by the firm.

1.4. Our firm is a learning organization.

2. Technological orientation (1 "Totally disagree"; 7 "Totally agree").

2.1. Top management ensures adequate funding of technology research and development.

2.2. Top management restructures work processes to leverage technology opportunities in the organization.

2.3. The firm has the competence to generate advanced technological processes.

2.4. The firm possesses the competence to assimilate new technologies and useful innovations.

2.5 The firm has the competence to obtain information about the status and progress of science and relevant technologies.

3. New Business Venturing (1 "Totally disagree"; 7 "Totally agree")

3.1. The organization has stimulated new demands on the existing products/services in current markets through aggressive advertising and marketing.

3.2. The organization has broadened the business lines in current industries.

3.3. The organization has pursued new businesses in new industries related to current business.
3.4. The organization has entered new businesses by offering new lines and products/services.

4. Organizational performance

Relative to your main competitors, what is your firm's performance in the last three years in the following areas? (1 "Much worse than my competitors", 7 "Much better than my competitors").

4.1. Organizational performance measured by return on assets (ROA)
4.2. Organizational performance measured by return on equity (ROE)
4.3. Organizational performance measured by return on sales
4.4. Organization's market share in its main products and markets
4.5. Growth of sales in its main products and markets

3.7. References

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CAPÍTULO 4

THE RELATION BETWEEN

R&D SPENDING AND PATENTS:

THE MODERATING EFFECT OF

COLLABORATION NETWORKS*

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The relation between R&D spending and patents: The moderating effect of collaboration networks

Abstract

To become more inventive and improve their market positions, firms are increasingly engaging in different collaboration networks around the globe. These collaborations facilitate knowledge and technology exchanges that, combined with R&D activities, may enhance the chances of patenting. However, the location and types of these networks conditions the differential benefits companies might gain from cooperating with others, influencing firms' ability to developing patentable outcomes. Therefore, this study examines the question: How do collaboration networks affect the relation between R&D spending and patents**?** Our findings, based on data from 5389 Spanish firms over the 2009-2011 period, suggest that firms that invest in R&D and join national and regional collaboration networks show a stronger propensity to patenting than companies that do not join these networks. Engaging in international collaboration networks, with partners from distant locations, does not significantly affect the firm's propensity to convert its R&D into patents.

Keywords

R&D, patents, collaboration networks

4.1. Introduction and Study Objectives

Recently, the European Commission (2013) reported that business sectors of the most innovative countries in the European Union stand out by spending heavily in R&D expenditure and filing patent applications. This trend is consistent with patterns observed in innovative companies around the world. To illustrate, Eurostat estimated in its last statistics that European Union (EU-27) business enterprise R&D expenditure rose to €160 billion in 2011 (approximately $214 billion). During the same period, the US National Science Foundation (2013) reported that American companies spent $294 billion in R&D, compared to $279 billion during 2010. In terms of patenting, only in the European Patent Office 65,687 patents were granted in 2012; the highest number in its history, and a 5.8% more than 2011 (EPO, 2013). Most patents went to US firms, followed by German, Japanese, French, and Swiss applicants. What is remarkable is that in the most innovative countries of the world, these companies have applied for patents to protect their discoveries from R&D.

The relationship between R&D and patenting has inspired considerable research interest over the past two decades (Griliches, 1990; Hall and Ziedonis, 2001; Penner-Hahn and Shaver, 2005; Somaya et al., 2007). This interest stems from the role R&D and patents play in sustaining the foundation of knowledge-based competition, influencing the scope and the opportunities available to the firm, and improving the potential to achieve growth and profitability (Kaul, 2012). Research also underscores the vital importance of companies' R&D in increasing their stock of knowledge and the generation of inventions (Hagedoorn and Wang, 2012), and the use of patents, a key means of protecting intellectual property rights, to appropriate the returns of R&D and prevent imitation of firm inventions, among other reasons (Blind et al., 2006).

Even though past research has widely shown that R&D spending positively affects patenting activity (Hall and Ziedonis, 2001; Nicholls-Nixon and Woo, 2003; Penner-Hahn and Shaver, 2005), it also indicates that investing in R&D is not the only factor that conditions the decision to patent (Pérez-Luño and Valle-Cabrera, 2011; Somaya, 2012). Companies seem to benefit also from joining collaboration networks - i.e. linkages with other partners to share or purchase knowledge or technology (Ahuja, 2000; Trigo and Vence, 2012)- by stimulating R&D activities and harvesting these activities in gaining patents (Sampson, 2007). For instance, recent statistics of Eurostat (2011) in this area highlight that, in 2008, 24.2% of European Union (EU-27) innovative firms engaged in any type of national cooperation-arrangement, 11.2% joined European Union collaborations, and 7.6% cooperated with agents in other countries (i.e. USA, China, India, etc.). These figures show that collaboration networks can be domestic, regional or international (Berry, 2013; Wagner and Leydesdorff, 2005), and are embedded in particular contexts that vary in the types and amounts of knowledge. Consequently, these networks provide recipient firms with streams of knowledge that have unique and particular characteristics (Vasudeva et al., 2013). Because these collaboration networks house companies and institutions with different knowledge bases, they are likely to contribute to a firm's ability to patent differently, a proposition that has not been studied well in prior empirical research.

This study addresses the question: how do collaboration networks affect the relation between R&D spending and patents**?** It explores whether engaging in different geographical collaboration networks (i.e. national, regional, and international) influences the company's propensity to convert its R&D into patents. Companies that cross their national frontiers and become international are more likely to access greater sources of knowledge, which may improve their likelihood of patenting, since patents constitute a strategic asset for firms (Beneito, 2006). However, the combination of R&D with dissimilar external knowledge sources can complicate knowledge transfer, and decrease the possibilities of effectively using and benefiting from the partner's resources (Noseleit and De Faria, 2013). This may negatively affect the firm’s ability to come up with new outputs to be patented. These contradictory arguments and findings require resolution.

To answer the study’s research question, data from 5389 Spanish technology-based firms during the period 2009-2011 was analyzed. Spanish companies are among the top ten in investing in R&D in the EU. However, they still engage in considerably less collaboration networks and patenting activities than some of their European counterparts, which may limit the benefits they gain from R&D activities. The results of our analyses show that the positive effect of R&D spending on patenting is higher when companies engage in national and regional collaboration networks. However, partnering with more international collaborators does not influence the company's tendency to develop patentable R&D, consistent with recent findings that firms benefit differently from external knowledge sources that come from distinct geographical contexts (Berry, 2013; Iwasa and Odagiri, 2004; Vasudeva et al., 2013).

This study also extends the technology strategy literature (Cuervo-Cazurra and Annique-Un, 2010; Zahra and Bogner, 2000), by providing a deeper understanding on the relation between R&D spending and patents, and by explaining why firms that engage in different collaboration networks may follow distinct patterns of behavior in terms of their needs to convert their R&D into patents. The findings also address the strategic role of collaboration networks in the era of globalization. Moreover, this research contributes to the Knowledge-Based View (KBV) of the firm (Grant, 1996a; Nonaka and Takeuchi, 1995), by showing how the combination of knowledge gained through R&D activities and knowledge acquired from different national or international collaboration networks may influence the firm's ability to gain competitive advantage.

This remainder of the paper is structured as follows. The next section presents the study's theory and hypotheses. Then, the methodology and the empirical analysis to tests these hypotheses are explained, and the results obtained are discussed. Finally, the implications and limitations of this study, as well as recommendations for future research, are presented.

4.2. Theory and hypotheses

4.2.1. The relation between R&D spending and patents

R&D and patents constitute two critical strategic resources for a firm's success (Penner-Hahn and Shaver, 2005). For this reason, technology based companies around the world, like IBM, Microsoft, Apple, Samsung, Ericson, among many others, continuously make the effort to heavily invest in these resources to remain competitive over time. In current dynamic business environments, R&D spending is key to ensuring strategic renewal (Knott and Posen, 2009), developing new knowledge, and improving a firm's ability to invent and innovate (Alexy et al., 2013). Patenting is considered the strongest legal form of protection of R&D outcomes, helps firms to keep their competitive advantage derived from invention (Ceccagnoli, 2009), limits others' ability to copy and carry out duplicative inventions (Shane, 2001), and ensures the appropriability of the returns derived from R&D investments (González-Álvarez and Nieto-Antolín, 2007; Knott and Posen, 2009). In addition, patents represent an indicator of firms' strategic behavior (Blind et al., 2006; Hall and Ziedonis, 2001), and can attract venture capital funds, prevent suits, and help firms gain access to certain international markets (Blind et al., 2006; Pérez Luño and Valle-Cabrera, 2011). R&D and patenting are related, since R&D leads to the development of fundamentally new knowledge that sparks exploration and discovery, potentially leading to more patents. Thus, consistent with previous research, one would expect that higher levels of R&D spending will positively affect patenting performance (Mudambi and Swift, 2013; Nicholls-Nixon and Woo, 2003). Firms that invest more on R&D will increase their chances of discovering (patentable) inventions, given that they develop more fertile settings to come up with new solutions to the problems they face (Somaya et al., 2007).

However, although R&D activities may produce patents and other outcomes (products, systems and processes), several studies indicate that not all inventions are patentable, and not all inventions are patented (Köhler et al., 2012; Somaya, 2012). The latter is a phenomenon usual in countries like Spain, where firms invest importantly in R&D (ranked among the top 10 within the EU), but nevertheless submit few patents applications compared to firms in other EU countries (e.g. Sweeden, Finland, Netherlands, Germany, Austria, etc.) and other countries of the world. The difficulty of demonstrating the novelty of the invention, the expense associated with patents, the fact that patents take time to gain, and the existence of alternative mechanisms to protect from imitation by rivals, such as secrecy, make some companies reluctant to patent their discoveries (González-Álvarez and Nieto-Antolín, 2007; Teece, 1986). Further, the legal protection of intellectual assets through patenting can be costly, discloses information about innovations, and offers little value in dynamic and fast changing industries, where many patents present a limited life (Pérez-Luño and Valle-Cabrera, 2011; Zahra and Bogner, 2000). This fact, in turn, could deter companies from seeking patents based on their R&D. Thus, and contrary to widely held assumptions, some authors have failed to show a clear link between R&D spending and patenting (Bessen and Hunt, 2007; Arora et al., 2008). Others researchers have even suggested that patenting propensity can decrease with an increase of R&D expenditures (Hagedoorn and Duysters, 2002). In sum, despite these conflicting arguments, it is logical to assume that, controlling for other variables, higher R&D spending is conducive to greater patenting. Thus:

Hypothesis 1: Firms with greater R&D spending will have higher patenting propensity.

4.2.2. The moderating effect of national, regional and international networks on the relation between R&D spending and patents.

In this study, we propose that joining national and regional collaboration networks moderates the positive relation between R&D spending and patenting propensity, such that the relation is likely to become stronger when firms engage in networks with partners located in closer geographical areas. However, taking part of more international networks can negatively moderate the relation between R&D spending and patenting, since this relation becomes weaker when companies interconnect with other partners from farther foreign locations (figure 4.1).

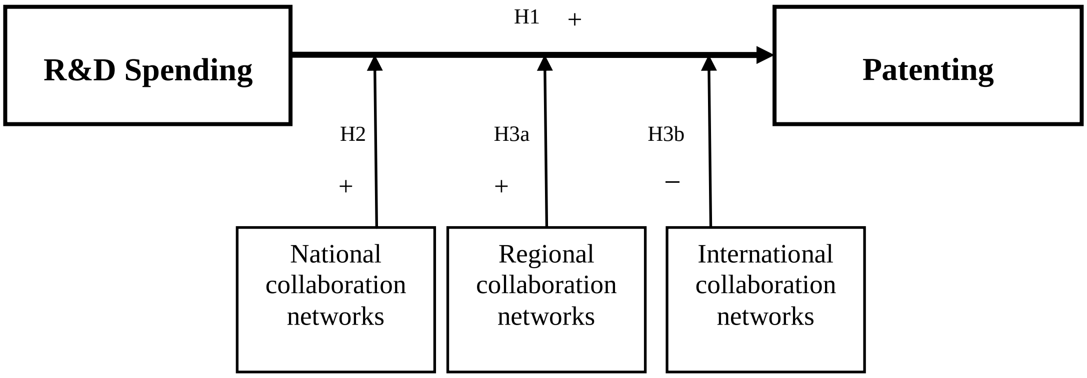


Figure 4.1. Proposed model

As explained earlier, knowledge flows, obtained from internal sources (i.e. R&D activities) and collaborations, represent a necessary input for developing new ideas and inventions (Giarratana and Mariani, 2013), and positively affect firms' patenting propensity, as companies seek to appropriate the returns of their inventing efforts (Ceccagnoli, 2009). According to the most recent data on collaborations in the Euro zone, provided by the *Science, technology and innovation in Europe 2011* report, over 2006–2008, one out of three innovative enterprises in the EU-27 cooperated with other agents in their nation, region (EU), or more international locations, in order to improve their innovative results. The highest number of collaboration agreements were found in Denmark (56.8 %), Cyprus (51.4 %), and Belgium (48.8 %), whereas Romania (13.8 %), and Italy (16.2 %) registered the lowest rate, not too far from Spain (18.7%).

In this scenario, one would expect that combining R&D activities with larger external knowledge sources, obtained through collaboration networks in national, regional, and international contexts, should increase the chances of developing patentable outcomes (Ahuja, 2000; Sampson, 2007). However, the knowledge that every partner of the network provides, -i.e clients, research institutions, laboratories, universities, or other firms, among others- is impregnated with the characteristics of the geographical area in which that linkage is located. Thus, although previous studies indicate that companies create value through a domestic and cross-border combination of valuable resources, such as knowledge (Berry, 2013; Kogut and Zander, 2003; Singh, 2008), not considering the specific contexts in which these collaboration networks operate, brings about a partial understanding of the influence of networks on firm-level outcomes (Vasudeva et al., 2013). Therefore, when analyzing the relation between R&D spending and patenting, and how the firm's collaboration networks may affect such relationship, it is necessary to distinguish different types of networks (i.e. national, regional, and international), in order to provide a more rigorous analysis of the relation proposed.

Partners from a similar context and similar attributes, such as those located in local clusters, or the same country, share a common culture, language, and skills that help knowledge transfer –i.e., the process of dyadic exchanges of knowledge between the sender and the receiver (Szulanski, 1996)-, and facilitate the combination of internal R&D and external sources (Noseleit and de Faria, 2013). In fact, some previous research provides evidence that organizations usually identify and absorb knowledge from other external knowledge sources more easily within their geographic proximity (Wagner et al., 2013). As a result, these companies, located in very similar and close geographical areas (i.e., nation), can readily improve their knowledge base and their absorptive capacity (Cohen and Levinthal, 1990; Zahra and George, 2002). Therefore, firms may find it strategic to hold a strong patent position, in order to raise money from capital markets, create some streams of revenue through licensing agreements, combat fierce competition in domestic markets, build a stock of rare and valuable knowledge, and obtain the funds required to keep nurturing R&D activities (Blind et al., 2006; Somaya, 2012).

Still, there are alternative and plausible explanations to our theory. Specifically, those companies that are exclusively locally oriented in their R&D spending and collaboration network partners may acquire redundant and overlapping knowledge. This can lead to a sub-optimal performance of the combination of the internal R&D and external partnerships (Noseleit and de Faria, 2013), thereby decreasing the odds of producing patentable inventions. Further, many firms (especially small ones, that frequently surpass the number of large corporations in a nation, and also new ventures), may lack the resources required to build their absorptive capacity and take advantage of the external knowledge flows their national networks provide, as they still do not possess enough complimentary resources (González-Álvarez and Nieto-Antolín, 2007; Teece, 1986). Accordingly, these companies may be reticent to patent, since the ability to protect an invention against appropriation hinges on the magnitude of complimentary assets (Shane, 2001).

Despite these arguments, multiple factors suggest that companies that benefit from R&D activities and collaboration networks located in the same geographical area may be more likely to convert their R&D into patents. Taking into account that proximity also increases knowledge spillovers, for example, via employee mobility (Agarwal et al., 2009), if nearby firms are endowed with enough absorptive capacity, they may try to exploit faster the knowledge and the opportunities that proximate organizations produced, increasing the imitation threats and appropriability concerns (Giarratana and Mariani, 2013). This fact, in turn, could boost the patenting propensity, as a defensive strategy to prevent these kind of opportunistic behaviors (Hall and Ziedonis, 2001). Moreover, patents can be used in these contexts as strategic mechanisms to mislead rivals in their efforts to build on the knowledge and technologies that patents disclosed. Hence, firms could strategically decide patenting "bad" inventions to disorient their competitors (Langinier, 2005; Somaya, 2012). Thus:

Hypothesis 2: The positive relation between R&D spending and patenting propensity is stronger in companies that engage in national collaboration networks than in those companies that do not.

Companies that effectively combine knowledge across country locations can achieve competitive advantages that other firms cannot replicate or surpass (Berry, 2013). In addition to the knowledge acquired through R&D spending, firms may benefit from being exposed to more varied non-overlapping sources of knowledge flows by collaborating with disconnected partners and clusters (Ahuja, 2000; Vasudeva et al., 2013). At the same time, these networking companies may benefit from reduced transaction costs, increased environmental adaptation, and the creation of competitive advantage (Bae and Gargiulo, 2004). Indeed, these knowledge flows, if appropriately transferred, could offer valuable, rare, imperfectly imitable and non-substitutable knowledge from foreign locations (Pérez-Nordtvert et al., 2008), what could push domestic firms to capture and appropriate such knowledge, by means of patenting, in order to preserve their competitive success (Alexy et al., 2013; Teece, 1986).

Many firms engaged in regional and international collaboration networks may be likely to gain patents from their R&D investments because, in international settings, patents constitute powerful tools to increase technological negotiations with potential collaborators, help firms consolidate their acceptance in cooperation networks, and enhance their market power overseas (Pérez-Luño and Valle-Cabrera, 2011; Somaya, 2012). That is, patents provide an opportunity to attract venture capital in new markets, allow firms to compete on the basis of differentiation, instead of costs (Shane, 2001), increase companies' bargaining power (Zahra and Bogner, 2000) and, overall, allow firms to improve their technological image and their ability to enter international markets (Blind, 2006). Importantly, these companies may conceive a strategic decision to develop patentable R&D, as the number and quality of patents gained constitute a signal for stakeholders and foreign outsiders to evaluate the firm's technological reputation, and can be critical to help firms overcome their liability of foreignness and consolidate their competitive positioning in non domestic markets (Lu and Beamish, 2004).

However, greater geographical distance reduces the necessary closeness required to facilitate knowledge transfer and, as a result, may impede productive combinations of internal and external knowledge flows that could nurture patenting activities (Jaffe et al., 1993; Singh, 2008). Although foreign collaboration networks allow companies to access new location-specific knowledge from overseas, a high level of dispersion may also create inefficiencies, and generates problems to coordinate partnerships, which in turn could make focal companies reactive to the knowledge they receive from "not reliable sources" (Berry et al., 2013). Under these circumstances, companies would need to develop coordination devices in order to guarantee the harmonization of the knowledge acquired from diverse external partners with the knowledge developed within the organization through internal R&D to obtain fruitful outputs (Foss et al., 2013). This, in turn, could be too costly. In addition, release of patented knowledge into different foreign markets can advance stronger competitors' production of alternative or improved technology, what may increase companies' preferences to protect their knowledge with potential commercial value with alternative mechanisms, such as secrecy, rather than with patents (Oviatt and McDougall, 2005).

In this study, we reconcile these diverse streams of literature as follows. Following Noseleit and de Faria (2013), but specifically applied to the international context, we claim that only those foreign linkages that provide moderately related knowledge and technologies (i.e., regional) may be the best balance between closeness and diversity of knowledge and, therefore, may allow the combination of internal R&D and partnerships to be productive, in terms of patenting. This means that the sources of knowledge acquired from distant locations (i.e., international) may not be understandable and well transferred (Sampson, 2007), absorptive capacity may become less effective (Cohen and Levinthal, 1990; Wagner et al., 2013), trust among parties may decrease, and collaboration with networks partners may cause disturbances within the focal organization (Berry, 2013), potentially reducing the likelihood of developing patentable R&D. These observations suggest the following hypotheses:

Hypothesis 3a: The positive relation between R&D spending and patenting propensity is stronger in companies that engage in regional collaboration networks than in those companies that do not.

Hypothesis 3b: The positive relation between R&D spending and patenting propensity is weaker in companies that engage in international collaboration networks than in those companies that do not.

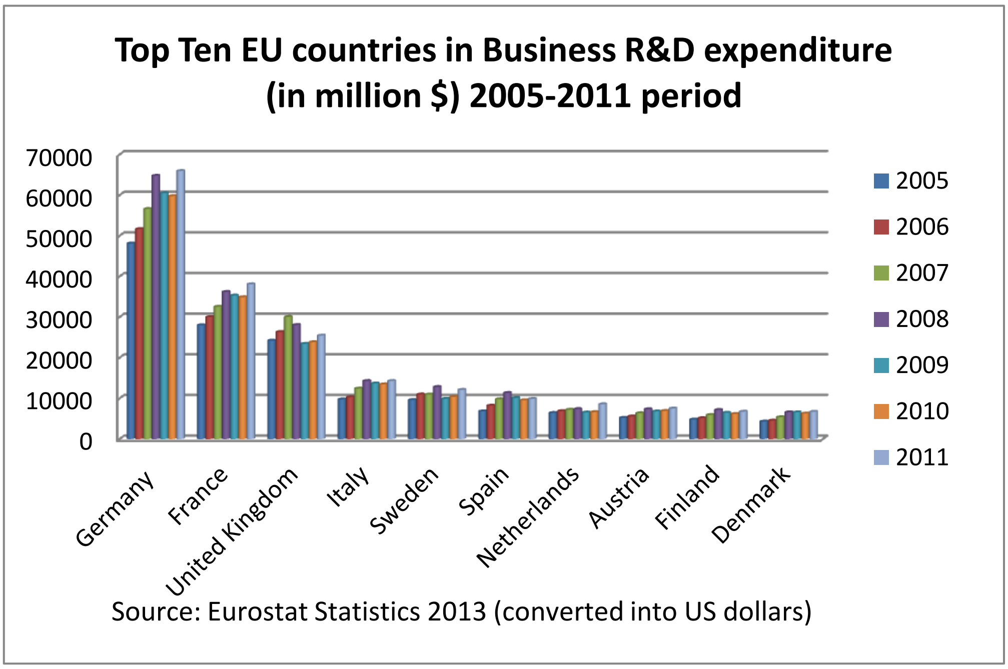
4.3. Method

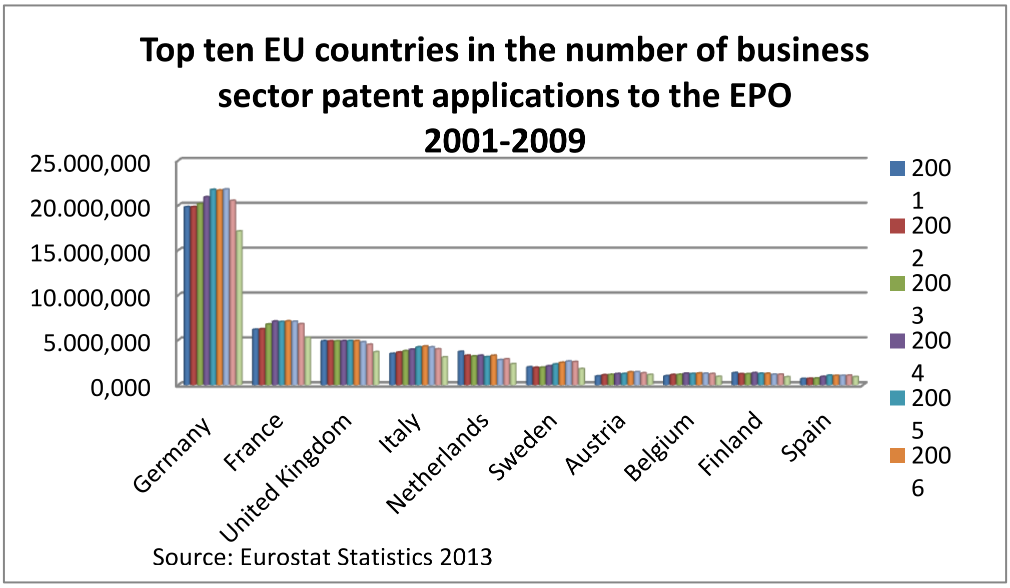
4.3.1. Sample and data

To test the study's hypotheses, data from Spanish technology-based companies was collected and analyzed, as the firm constitutes the unit of analysis of this research. The reason for choosing these type of companies has to do with the necessity of considering firms that usually invest in R&D and undertake inventions and innovations and, as a result, will be likely to get involved in patenting activities (Pérez-Luño and Valle-Cabrera, 2011). The companies studied were located throughout Spain, a country which is integrated within the European continent.. More specifically, Spain belongs to the European Union (EU-27) where, according to Eurostat (2010) statistics, business enterprise R&D expenditure rose from € 87.7 billion to 151.4 billion during the 1997-2008 period. These numbers highlight recent efforts made by private companies to increase their capability to develop new knowledge to remain competitive, concrete new ideas in form of patents, create new products, and improve market shares.

Studying technology-based companies in Spain is especially appealing that more than 60 % of the euro zone growth in R& D spending was accounted for by four countries: Germany, the United Kingdom, France and Spain. Despite such increase in business R&D investments, Spain still applies for considerably less patents that some of its European neighbors (Figure 4.2.). To illustrate, in 2010 Germany applied for 21724 patents to the European Patent Office, France 8741, the UK 4745, whereas Spain applied for 1454 patents to the same Patent Office (Eurostat, 2012). These conditions make the Spanish case especially interesting to examine, in order to clarify what factors could drive companies' emphasis on developing patentable R&D. In addition, Spanish firms are active in diverse collaboration networks, as a means to improve their knowledge base, innovation capability, and competitiveness (Barge-Gil, 2010). Overall, the research setting makes it particularly appropriate to analyze our research question and test our hypotheses.

Figure 4.2. Top ten EU countries in Business R&D expenditure and patent applications to the European Patent Office (EPO)





The dataset of Spanish technology firms was derived from the Technological Innovation Pannel (PITEC). Since 2003, this database is carried out yearly by the Spanish National Statistics Institute, and is supported by a group of university researchers, the Spanish Science and Technology Foundation (FECYCT), and the Foundation for Technological Innovation (COTEC). For each year, PITEC is composed of a stratified sample, according to the number of employees and sector (Escribano et al., 2009). Given that PITEC is an instrument to oversee the technological innovation activities of Spanish firms in a wide range of industries, and contains data relative to Spanish firms' technological resources, such as R&D spending, patents, and information about national, regional (EU), and international (i.e. US, China, India, among others) collaboration networks, it represents an adequate instrument to select our sample.

The data from PITEC is based on the Community Innovation Survey (CIS), a coordinated plan of the European Commission, the OECD, and the European Economic Area Member States, which is oriented towards obtaining information of technological innovation factors (Arranz and Fdez. de Arroyabe, 2008). Specifically, in our analysis we used the data that, following the European guidelines, the Spanish National Statistics Institute collected for PITEC from 2009-2011, by means of postal survey questionnaires that companies' CEOs had to fill out and return within 15 days. The response rate achieved was quite high, about 90%, what may be explained by the fact that Spanish companies are requested by law to complete and submit these questionnaires.

Our sampling frame consisted of all 2009 companies included within the Technological Innovation Panel, that is, 10891 Spanish firms. For the analysis, the sample was restricted to private companies -thereby excluding public organizations- that belonged to technology industries, either high, medium-high, medium-low, or low technology sectors. Further, those observations with missing values for the variables of interest were excluded (Somaya et al., 2007). Thus, we worked with a sample composed of 5389 Spanish technology firms. Despite the fact that PITEC database is available from 2003, the changing nature of the sample and of the questionnaire posed a challenge for some inter-temporal analyses (De Marchi, 2012). Considering that some of the variables of interest (i.e., some international networks, firm age), were included in PITEC from 2009 onwards, our empirical analysis focuses on the 2009-2011 period, as further discussed in the next section.

4.3.2. Variables and measures

The analysis included one dependent variable (patenting propensity), one independent variable (R&D spending), three moderator variables (national, regional, and international collaboration networks), and several control variables. Most of the study's measures followed past literature.

Dependent variable

Patenting propensity.

To measure firm's patenting propensity, previous studies have taken the annual number of successful patents applications (Bessen and Hunt, 2007; Brouwer and Kleinknecht, 1999; Hall and Ziedonis, 2001), as this measure reflects the will of the company to make use of such intellectual property rights. Following this stream of research, in this study, patenting propensity was measured as the sum of the total number of patents companies applied for in the Spanish Patent Office ("OEP"), the European Patent Office (EPO), the U.S. Patent and Trademark Office (UPSTO), and other international Patent Offices (PTC) over 2009-2011. We considered this period of time for two main reasons.

First, PITEC does not offer data for yearly patents applications. Second, we integrate diverse streams of literature, as some studies suggest it is appropriated to use same-period R&D to predict patenting outcomes (Hall and Ziedonis, 2001; Somaya et al., 2007), whereas others emphasize it takes a lag of time to convert R&D into patents, since the effects of knowledge and R&D on patenting are not simultaneous (Kondo, 1999; Pérez-Luño and Valle-Cabrera, 2011). In this way, and given that we considered in the analysis 2009 R&D spending, the relation between R&D spending and patenting propensity can be analyzed more rigorously.

Independent and moderator variables

R&D Spending.

In this study, R&D spending refers to the investments that firms undertake in research and development conducted in-house (within the firm), to increase the stock of knowledge and generate innovation results (Beneito, 2006). As such, external R&D is excluded, because it is provided by independent research organizations, from outside the firm and, therefore, could overlap with the knowledge that comes from some partners integrated within the firm's collaboration networks, considered in the analysis as moderator variables.

Consistent with the literature, R&D spending was measured using the log of the total internal R&D financial expenditures reported by a firm in a given year plus a constant (Henderson and Fredrickson, 2001; Fredrickson et al., 2010). In this case, 2009 was taken as the year of reference. Even though it is more frequent to use the measure of R&D intensity, as the ratio R&D expenditures/sales (Heeley et al., 2007; Keil et al., 2008; Laursen and Salter, 2006), firm size (the denominator) has already been included into our analysis as a control variable. Thus, it is more appropriate to use log-transformed R&D expenditures in order to reduce potentially biased results (Fredrickson et al., 2010).

Collaboration networks (national, regional, and international)

Collaborations networks were operationalized by considering the firm's total number of network collaboration partners within a three year moving window (Bae and Gargiulo, 2004), that is, 2009-2011. In particular, the annual survey asked companies to report their collaboration with: (1) other companies from the same group; (2) suppliers; (3) customers; (4) competitors; (5) commercial labs or private R&D institutes; (6) universities or other higher education institutions; (7) public research institutions; and (8) technology centers.

Since the variables of interest of our research are, specifically, national, regional, and international collaboration networks, we used the information provided by PITEC, that takes into account the geographical area in which these collaborations are located. Therefore, *national collaboration networks* were restricted to those embedded within the boundaries of Spain, *regional collaboration networks* included those operating within the European continent - Germany, Austria, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Slovakia, Slovenia, Estonia, Finland, France, Greece, Hungary, Ireland, Iceland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malta, Montenegro, Norway, Netherlands, Poland, Portugal, United Kingdom, Czech Republic, Romania, Sweden, Switzerland, and Turkey- and, eventually, *international collaboration networks* gathered those networks that expanded their linkages across farther locations overseas, such as the U.S.A, India, China, or other countries.

Control variables

A set of control variables, that could affect the firm's patenting propensity, was also included in the analysis. Consistent with the literature on patents, we controlled for firm size, firm age, industry type, past patenting experience, and level of exports. All these control variables refer to the year 2009, except for past patenting experience, which is for the 2006-2008 period. Firm size was measured using the log of a firm's sales (Penner-Hahn and Shaver, 2005). To capture firm age, the number of years elapsed since a company was founded was taken (Heeley et al., 2007). Firm industry was measured using dummies for high, medium-high, medium-low, and low technology sectors in Spain. The CNAE-2009 (i.e. industry) codes provided by PITEC enabled the classification of firms among these categories[2]. Further, we controlled for past patenting experience, since patenting propensity tends to increase when companies got involved in previous patent activities (Somaya et al., 2007). Past patenting experience was measured taking into account previous patent applications. It was coded using a dummy variable, where 1=past patenting experience, and 0=no past patenting experience. Finally, we controlled for firm's exports, using the log of the total exports, as this variable signal the internationalization of the firm, a factor which could be positively associated with patenting performance (Penner-Hahn and Shaver, 2005).

[2] **Industry classification**. *High tech industries*: aerospace, pharmaceuticals, computing and electronic machinery, optical devices, telecommunications, information and communication services, R&D services. *Medium-high tech industries*: Chemicals, electrical machinery and devices, other machinery and equipment, motor vehicles, transport equipment. *Medium-low tech industries*: Petroleum industries, rubber and plastic products, non-metallic mineral products, basic metals and fabricated metal products, building and repairing of ships and boats. *Low tech industries*: Food products, beverages and tobacco, textiles, textile products, leather and footwear, wood and cork, cardboard and paper products, printing and publishing.

4.4. Analysis

Since the dependent variable, firm's patenting propensity, is measured as the count number of patents applications, we used a negative binomial regression analysis to test the hypotheses. This method has been widely used in studies of patent output (Keil et al., 2008; Penner-Hahn and Shaver, 2005; Pérez-Luño and Valle-Cabrera, 2011). Even though Poisson regression is also adequate to analyze count data, this alternative was not appropriate in this case because the dependent variable presented overdispersion (mean of 0.55, S.D. of 4.92). Hence, it violates a basic assumption of the Poisson that variance of the count variable equals its mean (Yanadori and Cui, 2013).

Using hierarchical entry of variables in all regressions, we started with a base model that only included the control variables. In the second model, we added the main effect of the independent variables. Eventually, all the two-way interaction terms were included in the third, fourth, and fifth models. All independent and moderator variables were mean-centered before creating the interaction terms to avoid multicollinearity (Cohen et al., 2003).

4.5. Results

Table 4.1 presents the descriptive statistics, including the means, standard deviations, and correlations for all the study's variables. It shows that patent propensity is positively correlated with most of our control variables, which is consistent with our theoretical expectations. The correlation matrix also reflects that although some independent variables present statistically significant correlations, none of them were relatively high. In addition, Variance Inflation Factors (VIFs) were computed to examine potential multicollinearity problems. Given that all the VIFs scores

Table 4.1. Descriptive statistics and correlations

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
1. HIGHTECH	0.2	0.40	1	-,349**	-,284**	-,276**	,022	,251**	-,230**	-,258**	,122**	,125**	,052**	,065**	,030*
2. MEDHIGHTECH	0.33	0.47	-,349**	1	-,392**	-,381**	,085**	,080**	,052**	,179**	,127**	,005	,035**	,030*	,033*
3. MEDLOWTECH	0.24	0.43	-,284**	-,392**	1	-,310**	-,013	,049**	,075**	,030*	-,109**	-,079**	-,037**	-,049**	-,018
4. LOWTECH	0.23	0.42	-,276**	-,381**	-,310**	1	-,102**	,100**	,085**	,016	-,147**	-,044**	-,050**	-,045**	-,047**
5.PastPatents_dummy	0.13	0.34	,022	,085**	-,013	-,102**	1	,028*	,090**	,121**	,252**	,216**	,193**	,167**	,195**
6.Firm Age	26.33	18.27	-,251**	,080**	,049**	,100**	,028*	1	,369**	,262**	,079**	,034*	,067**	,033*	,079**
7. Firm Size	15.73	1.94	-,198**	,036**	,042**	,106**	,090**	,360**	1	,470**	,235**	,185**	,242**	,162**	,108**
8. Exports_logged	9.45	7.17	-,258**	,179**	,030*	,016	,121**	,262**	,469**	1	,245**	,107**	,165**	,115**	,082**
9. RD_logged	6.94	6.23	,122**	,127**	-,109**	-,147**	,252**	,079**	,222**	,245**	1	,359**	,278**	,185**	,121**
10. Spanish_networks	0.70	1.45	,125**	,005	-,079**	-,044**	,216**	,034*	,172**	,107**	,359**	1	,596**	,400**	,127**
11. EUnetw_logged	0.10	0.33	,052**	,035**	-,037**	-,050**	,193**	,067**	,236**	,165**	,278**	,596**	1	,526**	,138**
12. NonEUnetw_logged	0.04	0.21	,065**	,030*	-,049**	-,045**	,167**	,033*	,158**	,115**	,185**	,400**	,526**	1	,151**
13. Patents09-11	0.55	4.92	,030*	,033*	-,018	-,047**	,195**	,079**	,103**	,082**	,121**	,127**	,138**	,151**	1

***. Correlation is significant at the 0.001 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
c. Listwise N=5389

were below the acceptable threshold of five or ten (1.032 to 4.19 in this study), severe multicollinearity was not a major concern (O'Brien, 2007).

Table 4.2 displays the results of the negative binomial regression analyses. In line with previous arguments, the base model (model I) shows that all the control variables have a positive and statistically significant effect on patenting propensity ($p<0.001$). Thus, firm age, size, exports, and previous patenting experience, as well as operating in high, medium-high, and medium-low technology industries, had a positive impact on the company's patenting activity.

As shown in model II, there is a positive and statistically significant effect of R&D spending on patenting propensity ($\beta=0.15$, $p<0.001$). Thus, hypothesis 1, which stated that R&D spending is positively associated with patenting propensity, is supported. Importantly, as the likelihood ratio test (LRT) shows, this model makes a significant contribution over the base model (LRT= 476.72; $p<0.001$). The LRT is useful because it shows the significance of various models as compared to different base models (Srivastava and Gnyawali, 2011).

Next, model III tests the interaction between R&D spending and national collaboration networks. Given that the interaction effect is positive and statistically significant ($\beta=0.02$, $p<0.05$), hypothesis 2 is also supported. Hence, joining national collaboration networks strengths the positive relation between R&D spending and patenting propensity, as predicted. Further, model III makes a significant contribution compared to the main effects model (LRT= 7; $p<0.05$).

In a similar way, model IV tests the moderating effect of regional collaboration networks on the relation between R&D spending and patenting propensity, by adding the interaction term between R&D spending and regional collaboration networks. Since the parameter estimate for such interaction term is positive and significant ($\beta=0.05$, $p<0.05$), hypothesis 3a is supported. As in model III, model IV makes a significant contribution over and above the main effects model (LRT= 4.66, $p<0.05$).

Finally, model V, that tests the moderating effect of international collaboration networks on the relation between R&D spending and patenting propensity, shows that the interaction term between R&D spending and international collaboration networks is positive but not significantly related to patenting propensity ($\beta=0.004$). In addition, this model does not make any significant contribution to the main effects model II. Thus, hypothesis 3b is not supported.

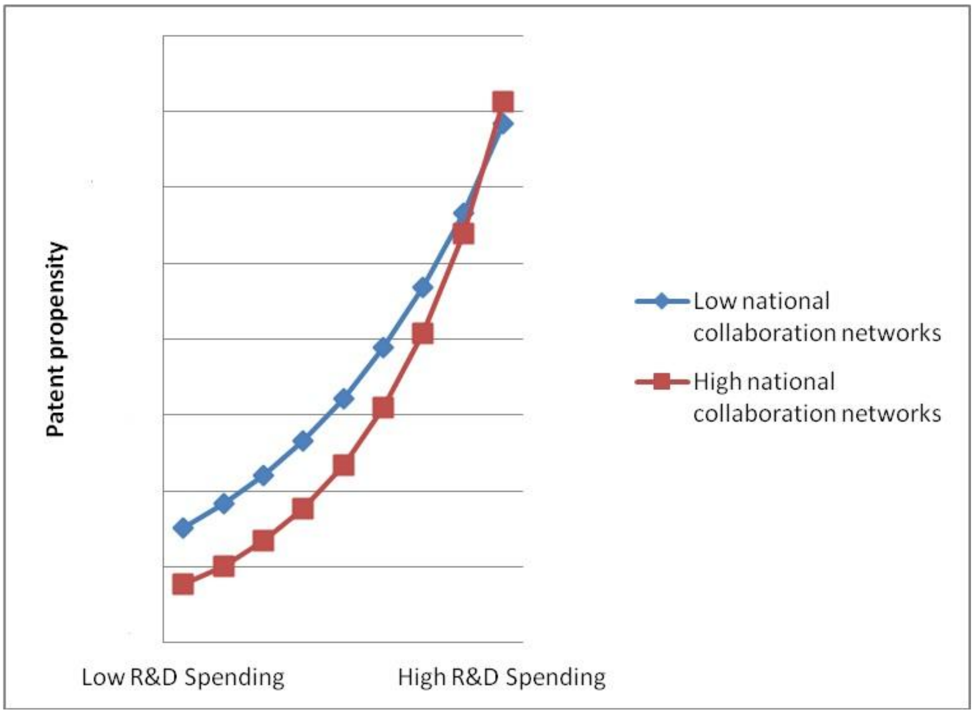
To corroborate the results just presented in Table 4.2., interaction terms were plotted in Figure 4.3.

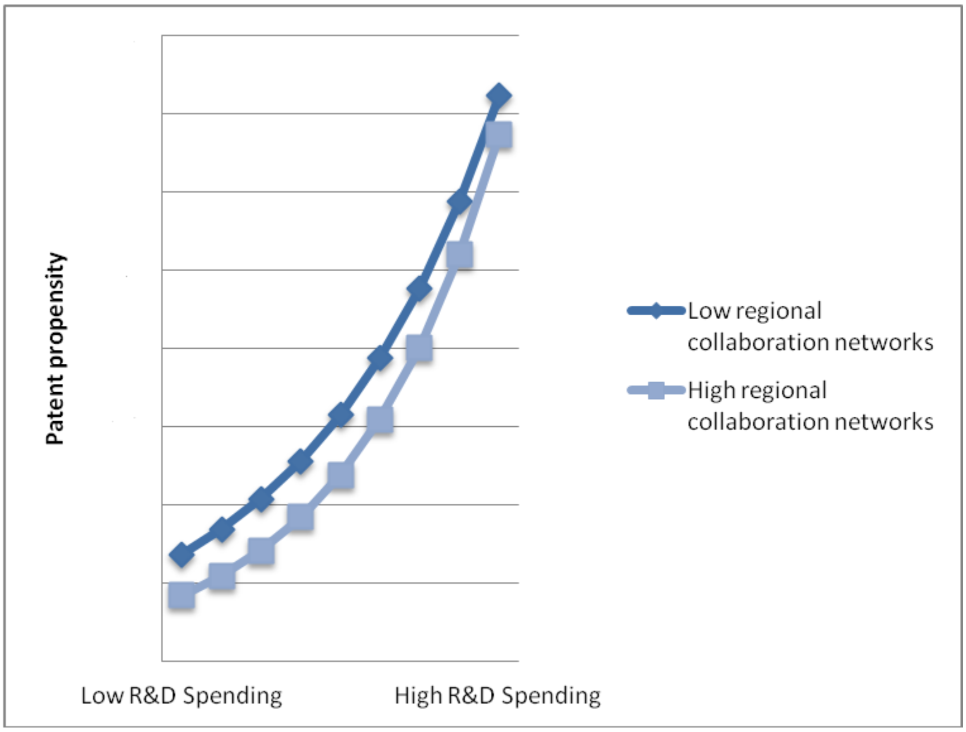
Table 4.2. Hierarchical negative binomial regression analysis for Patenting Propensity

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	-6.15***	4.40***	-4.29***	-4.29***	-4.40***
	(0.27)	(0.31)	(0.31)	(0.32)	(0.31)
High-Tech	1.52***	0.82***	0.77***	0.79***	0.82***
	(0.11)	(0.12)	(0.12)	(0.12)	(0.12)
Medium-High Tech	1.33***	1.02***	1.01***	1.01***	1.02***
	(0.10)	(0.11)	(0.11)	(0.11)	(0.11)
Medium-Low Tech	0.63***	0.56***	0.55***	0.56***	0.56***
	(0.11)	(0.12)	(0.12)	(0.12)	(0.12)
Past Patent Experience	2.35***	1.97***	1.99***	1.99***	1.99***
	(0.06)	(0.07)	(0.07)	(0.67)	(0.07)
FirmAge	0.02***	0.02***	0.02***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)
Firm Size	0.15***	0.05**	0.04*	0.04*	0.05**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Exports	0.04***	0.02***	0.02***	0.02***	0.02***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Internal R&D Spending		0.15***	0.15***	0.15***	0.15***
		(0.01)	(0.01)	(0.01)	(0.01)
National collaboration networks		0.001	-0.11*	-0.001	0.001
		(0.02)	(0.05)	(0.02)	(0.02)
Regional collaboration networks		-0.05	-0.08	-0.42*	-0.05
		(0.10)	(0.10)	(0.21)	(0.10)
International collaboration networks		0.39**	0.33**	0.35**	0.35
		(0.12)	(0.12)	(0.12)	(0.23)
InternalRD Sp. x National collab. networks			0.02*		
			(0.01)		
InternalRD Sp. x Regional collab. networks				0.05*	
				(0.02)	
InternalRD Sp. x International collab. networks					0.004
					(0.03)
Log likelihood	-3507.00	-3268.64	-3265.14	-3266.31	-3268.62
Likelihood Ratio Test (LRT)		476.72***	7**	4.66*	0.04
		[II-I]	[III-II]	[IV-II]	[V-II]

† $p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$. N= 5389.
Coefficient estimates (ß) and standard errors (in parentheses) are reported.

Figure 4.3. Interaction plots with patenting propensity as dependent variable





4.6. Discussion and conclusions

A growing body of research suggests that companies increasingly enter collaborative relationships that allow them to gain knowledge and improve their innovation. This study asks: Does engaging in different collaboration networks (i.e. national, regional, and international) affect the firm's propensity to convert its R&D spending into patents? Considering the location of the collaboration partners, the results of our study show that companies that invest in R&D and engage in national and regional collaboration networks show a stronger patenting propensity than those firms that do not join these networks. Participating in other international collaboration networks, where partners are farther geographically located, does not significantly affect the relation between R&D spending and patenting. These findings contribute to theory and practice, as discussed next.

4.6.1. Implications for theory

The results add to the technology strategy literature on R&D spending and patents (Pérez-Luño and Valle-Cabrera, 2011; Mudambi and Swift, 2013). Recent research has shown interest in exploring the factors that may drive patenting, in addition to R&D. Patents enable companies to appropriate their inventive efforts, sustain their knowledge-based competitive advantage, and favor superior economic performance (Ceccagnoli, 2009). Given that different geographical collaboration networks constitute mechanisms that favor knowledge and science exchanges, analyzing their interaction with R&D may help understanding why some firms present higher patenting activities.
Hence, the study underscores the importance of these collaboration networks when studying a firm's technology strategy decisions, especially patenting.

Consistent with hypothesis 1, our analyses corroborate the positive effect of R&D spending on patenting propensity reported in the literature (Hall and Ziedonis, 2001; Somaya et al., 2007). In addition, consistent with hypothesis 2 and 3a, we have provided evidence that only engaging in national and regional collaboration networks enhances the firm's tendency to harvest patents from its R&D investments. Although cooperation with network partners favors knowledge and technology exchanges, firm's only benefit from combining their R&D with the knowledge and resources they gain from domestic or non-domestic collaboration networks closely located. This geographic proximity, linked to some common attributes, is critical to save costs and facilitate knowledge transfer through face to face interactions (Barge-Gil, 2010; Noseleit and de Faria, 2013). Notably, and contrary to well established principles, our findings suggests that not always greater sources of knowledge lead to more patentable outputs. In this sense, our results show that the geographical context where external resources are embedded conditions the advantages companies derive from such assets (Berry, 2013; Iwasa and Odagiri, 2004). As noted earlier, and consistent with hypothesis 3b, the knowledge and technologies obtained from collaborations located in very distant and dissimilar cultures are more difficult to transfer and integrate with R&D spending. Consequently, these inefficiencies impede fruitful combinations to boost the firm's tendency to develop patentable R&D.

This study also clarifies the strategic role of collaboration networks in global markets. Specifically, we provide a deeper understanding by examining national, regional and international collaboration networks. To date, few studies have taken into account these three levels of collaboration networks simultaneously. In fact, many of them particularly focus their attention on international collaboration networks (Leung, 2013; Wagner and Leydesdorff, 2005). Because many countries belong to regions that share some common features (i.e. European Union), bearing in mind this intermediate type of collaboration is key to offer a more accurate analysis of the outputs firms may obtain from these collaborations. To illustrate, our results indicate that although regional and international collaboration networks are strategic to gain knowledge about foreign markets, only regional networks positively and significantly affect the relation between R&D spending and patents.

Interestingly, according to the Science, technology, and innovation report 2011, some of the countries that lead the EU in business sector R&D spending and patenting, particularly emphasize their participation in national and regional collaboration networks. For example, in 2008, 39.1 %, 15.9%, and 11.6% French innovative companies joined national, regional, and more international collaboration networks, respectively. Similarly, 36.6% of innovative firms in the Neetherlands collaborated with national partners, 21.1% with regional ones, and 15.6% participated in more international collaborations. Still far from some of the leading countries, in 2008 only 17.7%, 4.4%, and 2.3% of Spanish innovative firms, respectively, took part in national, regional, and international collaboration networks. These statistics are consistent with the finding of our study on different notesOn They alos show that companies still rely more on partners in relatively close locations to cooperate, for practical and strategic reasons (i.e. improving patenting outcomes). Still, it seems clear investing in R&D is not enough. In Spain, many firms fail to recoup their investments in R&D in form of patents, as they isolate more frequently than some of their European counterparts, in terms of cooperation. As our results show, only those companies that engage in national and regional networks achieve a stronger patenting propensity, with the consequent benefits these assets provide.

Finally, and grounded in the KVB of the firm (Grant, 1996a), the analyses show that, in a world where global competition is increasing, companies reinforce their appropriation mechanisms (i.e. patents) to preserve the favorable competitive advantages they gain through the possession of valuable knowledge (Teece, 1986). The analyses, furthermore, indicate that firms strengthen their reliance on developing patentable R&D just when they enter national and regional partnerships. In these domestic and non-domestic environments, concerns related to knowledge spillovers to proximate neighbors could explain the fact that replication threats increase (Giarratana and Mariani, 2013), as well as patenting propensity. Also, in these settings firms may integrate more easily their R&D with similar external resources obtained through collaboration networks, what favors getting new patentable outcomes. Thus, our findings suggest concern with appropriation may be higher at the national and regional level, what highlights the special strategic role patents play in such contexts to preserve knowledge-based competitive advantages.

4.6.2 Implications for practice

The results already presented have several implications for practice. One of the most relevant decisions managers face has to do with the design of the technological strategy, that is, the firm's choices related to how to develop and exploit its technological resources, such as R&D and patents (Zahra and Bogner, 2000). Even though there is no formula to ensure market success, managers must be aware that companies that invest in R&D may get considerable advantages by favoring strategic renewal (Knott and Posen, 2009) and nurturing patenting activities (Ceccagnoli, 2009). As noted earlier, patents do not only protect R&D outcomes from being imitated by competitors, but also constitute important strategic assets that companies may use to improve their reputation, internationalize, engage in technological alliances and networks, attract venture capital, or generate licensing income (Blind et al., 2006).

The findings of this study also suggest that companies interested in increasing their patenting activities as a strategic action should consider spending more on R&D and joining collaboration networks located in close geographical areas. This proximity makes the coordination of tasks easier, and companies may enjoy time and costs savings (Barge-Gil, 2010) and may lead to more successful resource combinations. Conversely, we have shown that, although more international collaboration networks may be a great source of knowledge from foreign locations, cultural and physical distance may create inefficiencies that reduce the number of potential patentable outputs. Thus, when managers perceive the knowledge or technologies obtained from domestic or non-domestic collaboration networks as having the potential to be combined with their own R&D, firms should place special emphasis in creating cross-functional teams, communication channels, or liaison groups to facilitate knowledge integration (Foss et al., 2013). Further, they could consider establishing R&D sites near the knowledge intensive locations, in order to favor the reception of knowledge and resources (Iwasa and Odagiri, 2004). Overall, holding a strong patent position to preserve R&D results could be used as a strategic choice to protect and guarantee the inimitability of their potential source of competitive advantage (Pérez-Luño and Valle-Cabrera, 2011).

4.7. Limitations and future research

Despite its potential contributions to theory and practice, the study has limitations that should be considered when interpreting or applying the results. First, this research was carried out in only one country (Spain), suggesting a need for replications and extension using data from other countries. Given that other external environmental conditions (e.g., legal system, institutional context) not taken into account in this study could affect the tendency to convert R&D spending into patents (Cohen et al., 2002; González-Álvarez and Nieto-Antolín, 2007), additional empirical analyses would be useful in validating the current results and determining their validity under different conditions (e.g. other countries). It is important also to bear in mind that our findings refer to private technology-based companies, and thus might not extend to public organizations or companies operating in non technology-based industries. Further empirical research is needed to assess how engaging in national, regional, and international networks may affect the patenting propensity of public organizations or non-technology-based firms that perform R&D activities.

Supporting the literature, our analyses show there is a positive relation between R&D spending and patenting propensity (Nicholls-Nixon and Woo, 2003; Somaya et al., 2007). This relationship becomes stronger when companies join national and regional collaboration networks. Yet, as stronger patent rights might help firms to recoup more of their R&D spending, stronger patent regimes could also increase firms' incentives to undertake R&D investments (Hall and Ziedonis, 2001). Hence, longitudinal studies to clarify this issue are needed.

Our measure of collaboration networks focuses exclusively on the number of partners that integrate the firm's networks; either national, regional or international. This fact makes it difficult to capture how intense the interactions with each one of these partners are. Future research should examine the moderating effect of each type of collaboration network (e.g., clients, universities, competitors, research centers, so on) in domestic and non-domestic settings, to determine how they particularly affect the relation between R&D and patenting propensity.

Finally, patents are quite heterogeneous in their value. Consequently, it would be interesting to consider the economic and technological quality of patents -i.e. based on number of citations-, rather than just focusing on patent counts alone (Singh, 2008). This would make it possible to provide a more rigorous analysis in future studies considering how patents add value to the firm.

4.8. Conclusion

Companies invest heavily in R&D, aiming to promote discovery and creation of new knowledge often in the form of patents. This study shows that companies strengthen their propensity to develop patentable R&D when they engage in national and regional collaboration networks. This may reflect these firms' gains from their ability to combine their internal R&D with knowledge obtained from network partners However, cooperating with more international partners does not significantly affect the positive relation found between R&D and patents, probably because knowledge transfer problems, as well as the diversity of knowledge and its sources, makes integration difficult. We hope our key findings encourage future research that documents the role of collaboration networks in R&D and patenting activities, especially in view of the growing internationalization of collaboration networks.

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CAPÍTULO 5: CONCLUSIONES, LIMITACIONES, Y FUTURAS LÍNEAS DE INVESTIGACIÓN

5.1. Conclusiones

5.1.1. Conclusiones del Trabajo de Investigación

El presente capítulo sintetiza las aportaciones más importantes ofrecidas a lo largo de este trabajo. Inicialmente, se muestra la principal contribución de este estudio, seguida de las aportaciones individuales de cada uno de los capítulos presentados en esta tesis doctoral. A continuación, se muestran las implicaciones más relevantes del trabajo, tanto a nivel teórico como para la práctica de la gestión empresarial. Posteriormente, se presentan algunas de las limitaciones de las que adolece este estudio, con posibles acciones de mejora. En línea con lo anterior, y ya en último término, se proponen una serie de futuras líneas de investigación, que permitan profundizar y mejorar más aún nuestro conocimiento en el campo analizado.

De forma global, este estudio ha ofrecido evidencia teórica y empírica de que aquellas empresas que gestionan estratégicamente sus activos tecnológicos y de conocimiento son capaces de obtener mejoras en su desempeño organizativo. Particularmente, y en otras palabras, aquellas organizaciones que se caracterizan por fomentar la implantación tecnológica, gracias al compromiso de la alta dirección, por un lado, y la potenciación de los recursos, capacidades y competencias tecnológicas, por otro, son más innovadoras, generan más conocimiento, presentan un mayor crecimiento (ej. creación de negocios), y obtienen mejores resultados financieros.

Estos hechos tienen especial trascendencia. En los actuales entornos de negocio, donde proliferan los continuos cambios y la necesidad de innovar, cada vez son más numerosas las empresas que enfatizan el papel de los recursos tecnológicos y el conocimiento, pues dichos activos se han asociado en múltiples ocasiones con la obtención de ventajas competitivas en estos escenarios (Ndofor et al., 2011; Yu et al., 2013). No en vano, la estrategia tecnológica organizativa influye de forma crítica en el rendimiento y en las posibilidades de supervivencia de una empresa (Zahra y Bogner, 2000). En este contexto, este trabajo ofrece una visión más concreta y explícita sobre cómo las empresas del sector tecnológico materializan esos potenciales beneficios derivados de la gestión de la tecnología. Como contribución adicional de este estudio, cabe destacar que los activos tecnológicos analizados (ej. apoyo de la alta dirección a la tecnología, inversiones en I+D, etc.) son claves en la generación de recursos (ej. patentes) y capacidades organizativas críticas (ej. aprendizaje, innovación) para mejorar la competitividad empresarial y el posicionamiento en los mercados (Martín et al., 2013). Estas conclusiones suponen una notable aportación en el marco de la teoría de recursos y capacidades (Barney, 2001; Eisenhardt y Martin, 2000; Wernerfelt, 1984), al resaltar la contribución específica de los recursos y capacidades de tipo tecnológico en la consecución de ventajas competitivas.

Tras señalar las conclusiones generales más destacables de este trabajo, a continuación se detallan las aportaciones más específicas.

En el capítulo 2, que lleva por título “Technological distinctive competencies and organizational learning: Effects on organizational innovation to improve firm performance”, los resultados obtenidos indican que el apoyo de la alta dirección a la implantación de nuevas tecnologías en la empresa es crítico para el desarrollo de nuevas habilidades y competencias tecnológicas, y aprendizaje organizativo. A su vez, esto tiene importantes repercusiones a nivel empresarial. Aquellas empresas que destacan por su dominio de competencias tecnológicas, y que tienen más facilidad para crear, compartir y utilizar conocimiento, aprovechan mejor las oportunidades estratégicas del entorno, están más capacitadas para desarrollar nuevos productos y servicios, y alcanzan un desempeño superior (Linton y Walsh, 2013; Marino, 1996; Real et al., 2006).

Por tanto, se han profundizado las consecuencias que pueden derivarse del apoyo de la alta dirección a la tecnología, como antecedente del desarrollo de recursos (ej. habilidades tecnológicas), competencias (competencias tecnológicas distintivas), y capacidades (aprendizaje, innovación organizativa) claves para la mejora de la posición competitiva de las empresas tecnológicas en los mercados actuales. Ante continuos cambios tecnológicos, las empresas deben esforzarse por adaptarse y modernizarse tecnológicamente para poder sobrevivir, con el objeto de evitar su obsolescencia. En este escenario, la alta dirección ha de ser responsable de dirigir el cambio (Bolívar et al., 2012).

Igualmente destacable, como consecuencia del compromiso de la alta dirección y el incremento de las habilidades y competencias tecnológicas, es la mejora de la creatividad y la búsqueda de nuevas alternativas a los problemas a los que la empresa se enfrenta, lo cual tiene claras implicaciones positivas en el desarrollo del aprendizaje organizativo y la capacidad de innovación (Yu et al., 2013). En entornos turbulentos, la introducción de nuevos productos y servicios es necesaria para promover la renovación organizativa, la adaptación de la empresa a los cambios, y la satisfacción de los clientes potenciales (Smith et al., 2005). Este estudio ha señalado que fomentar culturas de aprendizaje en estos contextos favorece la adquisición de nuevo conocimiento requerido para innovar. En última instancia, además, las empresas que facilitan el desarrollo de conocimiento, y la comercialización de nuevos inventos, son las que obtienen mejores niveles en su desempeño, y las más capacitadas para alcanzar fuentes de ventaja competitiva sostenibles en el tiempo (Jiménez y Sanz, 2011).

El capítulo 3, "Organizational learning and new business venturing: The moderating role of the firm's technological orientation", ha mostrado que aquellas empresas de base tecnológica que se caracterizan por promover el aprendizaje organizativo, y que además destacan por poseer una alta orientación tecnológica a nivel corporativo, son más activas a la hora de desarrollar acciones emprendedoras de creación de nuevos negocios que aquellas empresas que no potencian una orientación tecnológica. Asimismo, los resultados de este estudio concluyen que, en empresas de base tecnológica, la ampliación de los negocios actuales repercute positivamente en la mejora el desempaño organizativo en términos financieros.

De forma notable, este capítulo contribuye a la literatura que relaciona estrategia tecnológica y emprendimiento. En este sentido, ofrece una visión que clarifica argumentos contradictorios existentes en este campo. Por un lado, es cierto que no siempre tener mayor conocimiento y una mayor habilidad para crear productos innovadores y así satisfacer nuevos mercados conduce necesariamente a la creación de nuevos negocios en empresas establecidas (Covin y Miles, 2007). Sin embargo, en el contexto de empresas tecnológicas, nuestro estudio pone de manifiesto que aquellas compañías que generan y explotan más conocimiento relativo a los mercados, clientes, o avances tecnológicos, potenciado complementariamente tanto por procesos de aprendizaje como por el desarrollo de la orientación tecnológica a nivel organizativo, presentan una tendencia más fuerte a captar nuevas oportunidades basadas en la creación de nuevas líneas de negocio (Huang, 2011; Martín et al., 2013).

Especialmente destacables son las consecuencias que se derivan de la creación de nuevos negocios en el desempeño organizativo. Los resultados obtenidos indican que si bien el desarrollo de nuevas líneas puede ser costoso, tanto por las inversiones que se requieren, como por la complejidad de integrar de manera formal o informal a distintos niveles organizativos (Zahra, 2006), la realidad muestra que el desarrollo de nuevos negocios es crítico para el crecimiento y desempeño empresarial (Keil, 2009). En empresas de base tecnológica, la creación de nuevos negocios favorece la explotación de nuevas oportunidades, la generación de capacidades para competir en nuevos ámbitos o industrias, y la satisfacción de segmentos del mercado de forma pionera. Este hecho, a su vez, es clave para la mejora del crecimiento y los beneficios empresariales (Bojica y Fuentes, 2011; Narayanan et al., 2009).

Finalmente, en el capítulo 4, "The relation between R&D spending and patents: The moderating effect of collaboration networks", se concluye que las empresas que forman parte de redes de colaboración, con universidades, competidores, centros de investigación, etc. a nivel nacional y regional (ej. España y la UE, respectivamente, en el caso de empresas españolas), muestran mayor propensión a patentar las invenciones que resultan de sus inversiones en I+D que las empresas que no tienen estos tipos de cooperación. Además, los resultados mostraron que la participación en redes de colaboración más internacionales (ej. EEUU, China, o India,) no tiene ningún efecto significativo en la relación entre I+D y propensión a patentar.

Nuevamente, se pone de manifiesto cómo la combinación apropiada y efectiva de recursos, como son la I+D interna de la empresa con el conocimiento y la tecnología que intercambia cuando colabora con otros agentes cercanos o culturalmente similares, potencia la creación de nuevos activos (patentes), que pueden ser especialmente útiles para la mejorar la posición competitiva de la organización. Y es que, el desempeño en términos de patentes constituye una señal a los mercados, tanto de la capacidad inventiva de la empresa como de su fortaleza tecnológica, lo que puede repercutir positivamente en el incremento de su rentabilidad y valor en el mercado (Ceccagnoli, 2009; Somaya et al., 2007).

Además, se ha destacado que patentar los resultados de las actividades de I+D, como opción estratégica, se da con más intensidad cuando las empresas se alían con colaboradores geográficos no muy distantes (ámbito nacional y regional), posiblemente por la mayor posibilidad de difusión de conocimiento a competidores cercanos que, si además gozan de la capacidad de absorción adecuada, podrían favorecerse fácilmente de los esfuerzos inventivos realizados por una empresa a través de sus inversiones en I+D. En definitiva, la empresa sería más propensa a patentar en estos escenarios para apropiarse y proteger sus ventajas competitivas basadas en el conocimiento, frente a otros rivales del mercado.

Finalmente, y de forma notable, se ha abordado la relevancia que tienen las redes de colaboración, en distintos ámbitos geográficos, como mecanismos que fomentan la integración de ideas, experiencias, y habilidades para favorecer el desarrollo de nuevas invenciones a través de la combinación de distintas fuentes de conocimiento (Onal Vural et al., 2013). Por tanto, se ha tratado una cuestión clave para favorecer la consecución de ventajas competitivas a nivel organizativo (Alexy et al., 2013).

5.2. Implicaciones del Trabajo de Investigación

5.2.1. Implicaciones Teóricas

Las conclusiones presentadas conducen a una serie de implicaciones de interés desde el punto de vista académico. A continuación, procedemos a detallar específicamente las principales implicaciones teóricas. Para mayor claridad, analizaremos las contribuciones teóricas de cada capítulo presentado.

En primer lugar, el capítulo 2 ha mostrado cómo el apoyo de la alta dirección a la tecnología conlleva efectos positivos y directos en el desarrollo de habilidades y competencias tecnológicas, y aprendizaje organizativo. Pero, simultáneamente, se ha dado un paso más al constatar también que el apoyo de la alta dirección a la tecnología indirectamente impacta de forma positiva: 1) en la creación de competencias tecnológicas, a través de las habilidades tecnológicas, y 2) en la generación de aprendizaje organizativo, a través las habilidades y las competencias tecnológicas. Adicionalmente, y de forma importante, en este capítulo se ha verificado que un incremento en las competencias tecnológicas y el aprendizaje organizativo favorecen, a su vez, la mejora del desempeño financiero de la empresa, de forma directa e indirecta a través de la innovación organizativa. Estas implicaciones arrojan luz sobre las trascendentes repercusiones derivadas del apoyo de la alta dirección a la tecnología, y sirven para explicar los procesos de interrelación entre recursos y capacidades organizativos clave para el posicionamiento competitivo de la empresa (Wilbon, 1999).

En relación al capítulo 3, se ha aportado una interesante contribución a la literatura que liga la estrategia tecnológica y los planteamientos emprendedores dentro de empresas de base tecnológica (Antoncic y Prodan, 2008; Martín et al., 2013). Es destacable la aportación que este trabajo realiza particularmente en el campo de la creación de nuevos negocios, como dimensión específica del espíritu emprendedor corporativo. En este sentido, se ha ofrecido evidencia teórica y empírica de que aquellas empresas que fomentan el aprendizaje organizativo y, además, promueven una intensa orientación tecnológica a nivel empresarial, se caracterizan por participar en más acciones relativas a la creación de nuevos negocios que aquellas empresas que no enfatizan la orientación tecnológica. Estas acciones refuerzan la capacidad para descubrir y crear nuevas oportunidades, aventurarse en territorios diferentes, en nuevas áreas, o en diferentes campos (Zahra, 2008), lo cual impacta positivamente la creación de nuevos negocios. Asimismo, los resultados de nuestros análisis han mostrado que la apertura de nuevos negocios es fundamental para alcanzar un mayor crecimiento y mejores resultados empresariales (Narayanan et al., 2009).

Finalmente, en el capítulo 4 se ha aportado evidencia teórica y empírica sobre cómo las distintas redes de colaboración geográficas de la empresa afectan la relación existente entre I+D y propensión a patentar. Por tanto, hemos atendido demandas actuales que inciden en la necesidad de investigar qué factores adicionales pueden influir en la tendencia de la empresa a convertir los resultados de sus inversiones en I+D en patentes (Pérez-Luño y Valle-Cabrera, 2011). Igualmente, otra contribución sustancial ha sido el análisis estratégico que se ha realizado sobre del rol que desempeñan las distintas redes de colaboración de la empresa dentro de la economía global. Para ello, se han distinguido los niveles nacional, regional, e internacional, con objeto de profundizar más en la tradicional separación entre redes de colaboración domésticas/no domésticas o, en otras palabras, nacionales/internacionales. Finalmente, hemos destacado que las patentes se perciben como un instrumento útil para garantizar las ventajas competitivas favorables que las empresas obtienen por poseer conocimientos valiosos (Teece, 1986), originado por sus actividades en I+D, especialmente cuando la empresa colabora con otros socios a nivel nacional y regional.

A modo de conclusión, y en líneas globales, se puede destacar que este trabajo muestra notables avances el campo de la estrategia tecnológica de la empresa (Martín et al., 2013; Ritter y Gemünden, 2004; Zahra y Bogner, 2000), al explicar cómo la gestión estratégica de la tecnología en la empresa, basada en el apoyo a la adopción de recursos tecnológicos y de conocimiento, conlleva importantes beneficios para el desempeño organizativo de empresas de base tecnológica, medido por su capacidad para desarrollar nuevo conocimiento e invenciones, crecer a través de la creación de nuevos negocios, y mejorar su habilidad para obtener mejores resultados financieros.

5.2.2. Implicaciones para la gestión

Además de las implicaciones teóricas ya presentadas, pueden destacarse varias implicaciones importantes para aquéllos dedicados a la práctica de la gestión empresarial. Al igual que se hizo anteriormente, en las implicaciones teóricas, mostramos de forma particular las contribuciones prácticas de cada capítulo.

Inicialmente, como consecuencia de los resultados obtenidos en el capítulo 2, ha de enfatizarse la necesidad de que la alta dirección promueva una estrategia corporativa basada en el apoyo a la tecnología (Liang et al., 2007). Para hacer operativo ese compromiso tecnológico, puede optarse por acciones estratégicas tales como la aportación de fondos a nuevos proyectos de I+D, la promoción de programas de formación tecnológica de los empleados, o la reorganización de los procesos organizativos para aprovechar, de forma efectiva, las oportunidades tecnológicas que se presenten (Bolívar et al., 2012). Si falta esta actitud proactiva, y se da una escasa atención a la estrategia tecnológica de la empresa, múltiples oportunidades que surjan en el entorno serán difícilmente explotadas (Štemberger et al., 2011). Sin embargo, si la alta dirección promueve el desarrollo tecnológico, con la consecuente involucración de todos los empleados, la empresa estará más preparada para poder afrontar de forma satisfactoria todos los retos que se le planteen, potenciando así su capacidad para competir con otros rivales de su sector. Este hecho es importante para potenciar competencias tecnológicas que permitan a la empresa estar a la vanguardia de su sector, tales como la habilidad para atraer al personal científico más cualificado, la capacidad para obtener y explotar la información tecnológica más relevante, o la competencia para generar procesos tecnológicos avanzados. Las empresas más competentes, además, son las que más aprendizaje generan. La creación y difusión de conocimiento se puede alcanzar asimismo situando a los directivos que tienen predisposición hacia el aprendizaje en posiciones decisivas en la organización (Swieringa y Wierdsma, 1992), y fomentando charlas sobre aprendizaje y trabajos en equipo (Jiménez y Sanz, 2011). En último término, todas estas acciones mejoran la flexibilidad de la empresa y su habilidad para generar nuevos productos y servicios, al nutrir a la organización con una serie de *inputs* que favorecen la mejora de su rentabilidad y crecimiento en los mercados.

En línea con estas contribuciones prácticas, el capítulo 3 vuelve a destacar la importancia de promover la orientación tecnológica a nivel empresarial. En este caso, se verifica que las empresas comprometidas con esta orientación estratégica potencian su capacidad para transformar el conocimiento generado a través del aprendizaje en nuevos negocios. Este hecho tiene gran trascendencia, ya que el desarrollo de nuevos negocios en empresas establecidas es crítico para garantizar una cultura innovadora a nivel empresarial, desarrollar nuevos productos y servicios para mercados actuales o potenciales, descubrir nuevas oportunidades estratégicas antes de que los competidores lo hagan (Block y MacMillan, 1993), y mejorar el desempaño organizativo (Keil et al., 2009). Así, todas aquellas empresas interesadas en aprender, como mecanismo para impulsar nuevos negocios, deberían promover la contratación o transferencia de empleados para promover intercambios de conocimiento, la creación de equipos inter-funcionales, o el establecimiento de sistemas de gestión del conocimiento (Schilling y Fang, 2013). Adicionalmente, si se quisieran potenciar los efectos del aprendizaje organizativo en la creación de nuevos negocios, la alta dirección debería mostrar un compromiso firme con la estrategia tecnológica corporativa. La promoción de proyectos tecnológicos, inversiones para implantar y desarrollar nuevas tecnologías, financiación de actividades de I+D, o programas de formación para mejorar la cualificación técnica del personal, entre otros, son acciones que claramente favorecerían el impulso de la orientación tecnológica, así como las actividades emprendedoras de empresas establecidas de base tecnológica (Martín et al., 2013).

Finalmente, el capítulo 4 de este trabajo resalta que los directivos han de tener en cuenta que, pese a no haber una fórmula exclusiva para el éxito, las empresas que invierten en I + D suelen obtener ventajas considerables respecto a sus rivales, puesto que desarrollan más conocimiento, favorecen la renovación estratégica (Knott y Posen, 2009) e influyen en la generación de patentes (Penner-Hahn y Shaver, 2005). La importancia de este asunto radica en que, por un lado, patentar ayuda a que la empresa se apropie de los resultados novedosos derivados de sus inversiones en I + D, evitando que sean copiados por competidores directos. Por otro, la posesión de patentes se considera como un activo estratégico que las empresas pueden utilizar para mejorar su reputación, participar en alianzas tecnológicas, llevar a cabo operaciones de internacionalización, generar ingresos por licencias, o incluso atraer a potenciales inversores (Blind et al., 2006). En este sentido, nuestro estudio sugiere que las empresas que pretendan reforzar su estrategia tecnológica potenciando la posesión de patentes, deberían plantearse realizar mayores inversiones en I+D y colaborar con socios (ej. universidades, competidores, clientes, proveedores, laboratorios, etc.) a nivel nacional y regional. Se ha verificado que, en estos casos, las combinaciones entre I+D interna de la empresa con los recursos obtenidos a través de redes de colaboración son más efectivas para la generación de patentes. Estos mecanismos promueven intercambios de conocimiento y tecnología valiosos, que cristalizarán en múltiples casos en patentes, como medio para proteger esas ventajas competitivas asociadas al conocimiento. Se ha constatado que la proximidad, y en cierto modo la similitud cultural, garantizan un ahorro de tiempo y costes importante (Barge-Gil, 2010). Por el contrario, incrementar las colaboraciones más internacionales podría garantizar el acceso a conocimientos sobre mercados más distantes, pero no tienen un efecto significativo en el fortalecimiento de la propensión a patentar de la empresa. Aquí, la distancia interfiere en la transferencia efectiva de conocimiento, la confianza entre las partes, y las habilidades para absorber conocimiento externo. De considerarse esta opción, sería muy importante promover equipos cros-culturales, e implantar mecanismos de coordinación más fuertes, con objeto de intentar superar las barreras que dificultan la combinación efectiva de recursos para la obtención de patentes.

En definitiva, y como principal propuesta para la gestión empresarial, derivada de los resultados obtenidos en este trabajo de investigación, cabe señalar que la gestión estratégica de la tecnología y los activos de conocimiento, a nivel organizativo, ha de considerarse un asunto clave para la competitividad de la empresa. Si bien es cierto que conlleva una serie de costes, y en ocasiones riesgos, no apostar por este tipo de estrategia puede conllevar un efecto negativo sobre los resultados de la empresa. Como se ha destacado, una empresa que invierte en recursos tecnológicos y conocimiento es una empresa más capacitada para aprender, para innovar, para potenciar la creación de nuevos negocios, y para incrementar la percepción positiva de sus clientes y potenciales socios en los mercados.

5.3. Limitaciones del Trabajo de Investigación

Este trabajo presenta una serie de limitaciones. A continuación, indicamos algunas de las más importantes.

En primer lugar, la presentación de análisis empíricos de corte transversal dificulta conocer cómo evolucionan las variables objeto de estudio a lo largo del tiempo. Por este motivo, podrían surgir dudas en algunos casos relativas a la causalidad. Pese a la existencia de este problema, hemos intentado reducirlo por medio de justificaciones basadas en la evidencia teórica (Hair et al., 1999).

Adicionalmente, han de destacarse las limitaciones relativas a la validez externa de los estudios presentados. Se han realizado análisis relacionados con la gestión estratégica de la tecnología en empresas del sector tecnológico situadas en España y Europa. Sin embargo, es difícil valorar si los mismos resultados se obtendrían en países diferentes (por ejemplo, Estados Unidos o China), o en industrias distintas. Por este motivo, no es posible disipar completamente las dudas en torno a la posibilidad de generalizar las conclusiones obtenidas en los artículos de investigación mostrados.

De la misma manera, cabe señalar que los datos aportados, al estar basados en informes completados por la alta dirección, pueden adolecer del sesgo de deseabilidad social (Podsakoff y Organ, 1986). Dada la sensibilidad de las cuestiones planteadas en torno a temas importantes para la organización, se garantizó el anonimato de los encuestados como medio para minimizar los posibles efectos de este sesgo (Konrad y Linnehan, 1995). No en vano, el conocimiento de la alta dirección, relativo a múltiples aspectos organizativos, sigue percibiéndose como especialmente valioso.

Otra limitación se deriva del hecho de que, aunque el test de un factor de Harman no identificó como problema el sesgo por método común, todavía es posible que éste se haya dado en los capítulos 2 y 3 (Konrad y Linnehan, 1995). Sería aconsejable que futuros análisis recogieran medidas de las variables dependientes e independientes procedentes de distintas fuentes, para minimizar los efectos de cualquier sesgo de respuesta (Podsakoff et al., 2003).

Otra problemática presente en este trabajo está relacionada con la selección de las variables. Para recoger procesos de creación y difusión de conocimiento, en el capítulo 2 utilizamos la variable aprendizaje organizativo, aunque quizá también podría haberse tenido en cuenta alternativas relativas a la gestión de conocimiento (Nonaka y Takeuchi, 1995), o la capacidad de absorción de conocimiento externo (Zahra y George, 2002). En el mismo sentido, el capítulo 3 determina cómo influye la orientación tecnológica de la empresa en la relación entre aprendizaje organizativo y creación de nuevos negocios. Podría haberse valorado cómo influye en otros aspectos relacionados con el emprendimiento corporativo y de gran interés también, como es el caso de la renovación estratégica. Finalmente, el capítulo 4 muestra el impacto moderador de las redes de colaboración de la empresa en la relación entre I+D y propensión a patentar. Más que la simple propensión a patentar, que no obstante es utilizada en múltiples estudios, la consideración de la calidad tecnológica y económica las patentes (medida por el número de citas), podría haber ofrecido unas conclusiones más relevantes, puesto que las patentes son muy heterogéneas en su valor (Singh, 2008).

5.4. Futuras Líneas de Investigación

En este apartado final, señalamos algunas ideas para orientar futuros trabajos de investigación.

Inicialmente, hemos de destacar que deberían realizarse estudios longitudinales, que permitiesen analizar con más exactitud la evolución de las variables a lo largo del tiempo, y que reforzaran las relaciones de causalidad propuestas.

Igualmente, debería valorarse la realización de estudios en países e industrias diferentes a los que ya se han analizado, y que incluyesen parte de las relaciones testadas en esta tesis doctoral, como medio para afianzar la validez externa de nuestras conclusiones.

Asimismo, dados los potenciales problemas relacionados con el sesgo de subjetividad social, anteriormente comentados, podría resultar interesante llevar a cabo estudios en los que los empleados o los directivos de nivel medio interviniesen en la valoración de cuestiones planteadas (por ejemplo, apoyo de la alta dirección a la tecnología, orientación tecnológica de la empresa, etc.).

De la misma manera, sería interesante tener en cuenta variables adicionales y/o alternativas en los modelos empíricos presentados, para ver las repercusiones que se derivan en el desempeño organizativo. Por ejemplo, respecto a los capítulos 2 y 3, podrían incluirse todas y cada una de las dimensiones que integran el espíritu emprendedor corporativo, pues éste denota actividades relacionadas con la innovación, proactividad, auto-renovación, y creación de nuevos negocios, que potencialmente pueden afectar positivamente al desempeño organizativo (Antoncic y Hisrich, 2001). En lo que se refiere al capítulo 4, verificar el efecto particular de cada tipo de socio (universidades, competidores, centros privados de investigación, etc.), en los contextos nacional, regional, e internacional, podría ayudar a conocer qué tipo de colaborador, y en qué contexto geográfico específico, influye más en la tendencia de la empresa a convertir los resultados de sus actividades de I+D en patentes.

Finalmente, futuros investigadores podrían considerar también la inclusión de variables moderadoras en los modelos propuestos, tales como el tamaño de la empresa, o el ciclo de vida de la misma. Así, se podría ofrecer un análisis más preciso que constatase si las relaciones que se han testado, relativas a la relación entre la gestión estratégica de la tecnología y el desempeño organizativo, se dan con la misma intensidad (o no) en pequeñas/grandes empresas, o en empresas de nueva creación/establecidas.

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