Internal and external factors for business development of academic spin-off - from laboratory to market

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Academic entrepreneurship

- Universities are an important source of entrepreneurial activity
  - generating technological knowledge that spills over (spillover) and is exploited by potential entrepreneurs (**knowledge spillover theory of entrepreneurship**) (Ghio et al., 2015)
  - Encouraging the creation of new businesses, especially by teaching and research staff (**academic entrepreneurship**) (Rothaermel et al., 2007)
  - In the form of new businesses created by students and recent graduates (**student entrepreneurship**) (Jansen et al., 2015)

The research spin-off company

“company operating in high-tech sectors consisting of (at least) a university professor / researcher and / or a doctoral student / contractor / student who has carried out multi-year research on a specific topic, the object of creation of the company itself” (Rapporto Netval, Piccaluga 2015).

According to this definition, the use by the company of intellectual property rights of the University is not a necessary condition for its identification as a spin-off, while in most cases the fact that the university holds a share of the capital corporate social security is a sufficient condition so that we can speak of a research spin-off company (except in cases where the company is clearly not high-tech).

Public research spin-offs: characterizing elements

- Similar to public research companies
- Companies founded by research personnel active in the parent organization (University).
- They are the most widespread category of research-based spin-offs (RBSO) (especially in Italy).
- They can differ from each other in function of:
  - the link with the parent organization (O'Shea et al., 2008);
  - the business model adopted (Ndonzuau et al., 2002; Lehoux et al., 2014).
- Despite these differences, they have particular "genetic" characteristics that influence their strategies (Ensley and Hmieleski 2005, Colombo e Piva, 2008; 2012).

Typological clarifications on the concept of spin-off

University spin-offs

- When the university holds a share of the spin-off's share capital
- The university's share is usually a minority one

Academic spin-offs

- The University, a public juridical person, does not enter the social capital
- they are usually supported by the universities of origin in different forms

Determinants in the context of the case

- **Corporate purpose**
- **High-tech requirement (not always present)**
- **The presence in the social structure of university staff**

+/-

- **Participation of the University in the social structure (sufficient condition)**
- **Use of intellectual property rights of the University (not always)**

Classic spin-off company activation process

The Proponent has to translate the IDEA in simple language, highlighting the potential applications and evaluating tangible and intangible resources necessary for its implementation

Dining all members of future spin-off to participate in training courses, workshops and conferences organized by the University TTO in management, administration and organization, PI, etc.

The TTO, even the outside consulting help of experts in economic and financial plans, guides the Proponent in writing a Business Plan and the proposal of Spin-off activation

Classic spin-off company activation process (follows)

TTO activation request → Evaluation By Spin-off Commission → Positive opinions from the DC → Opinion of the Academic Senate → Evaluation of the Board of Directors → **Approval for the establishment of the spin-off**

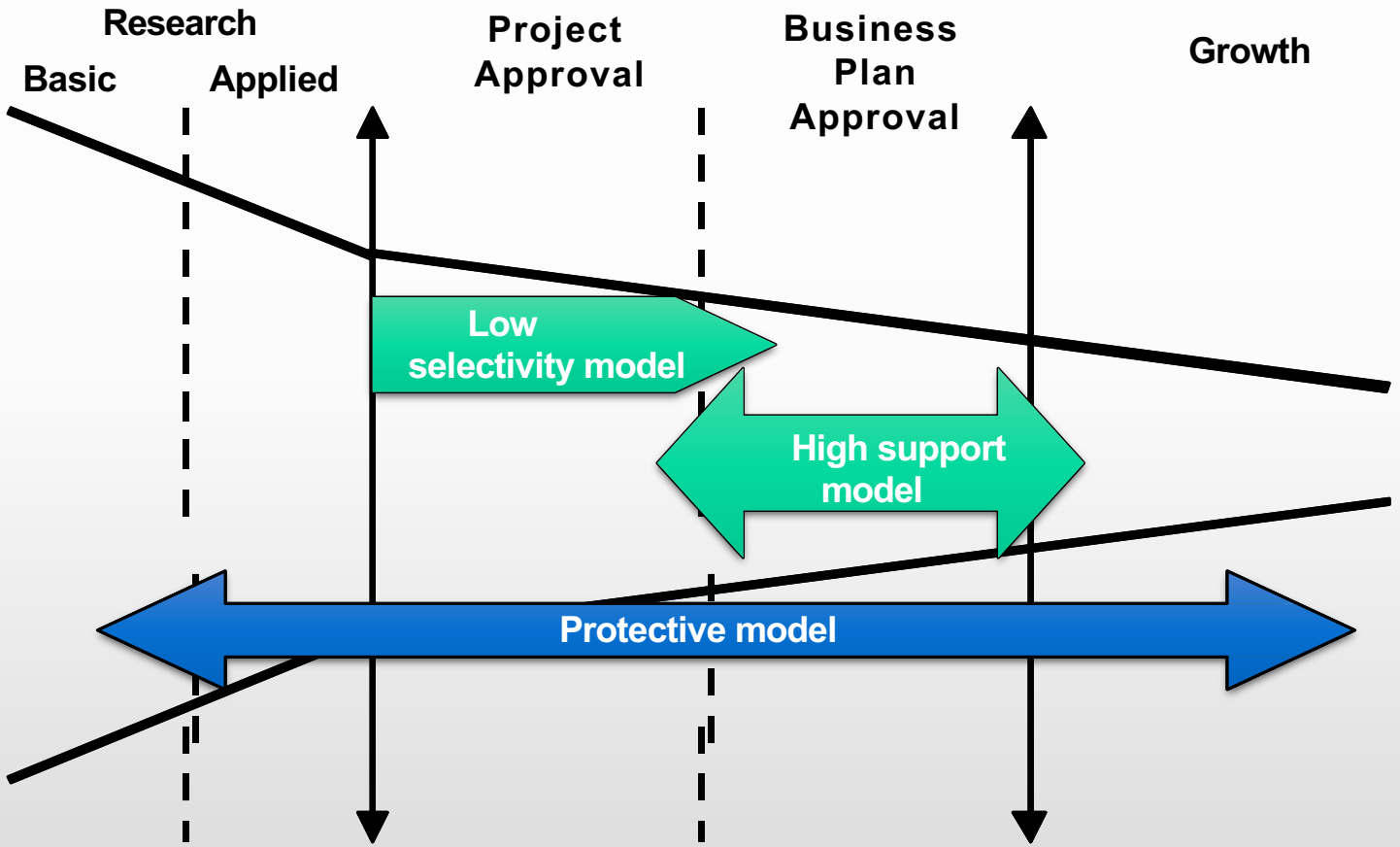
The proponent presents to the University the Activation Proposal for an Academic Spin off

The spin-off Commission conducts an investigation about the feasibility and interest of the initiative

The Department Council must authorize the Proponent to set up the Spin off. All the university staff that takes part in the company must be authorized by the structure to which they belong.
It also authorizes the use of any facilities granted to the spin-off.

If the spin-off intends to use university facilities and equipment, the advice of the Council of the host structure and the signing of the framework Convention become binding.

University spin-off creation / activation models
(Mustar et al., 2008; Lockett et al., 2005; Iacobucci & Micozzi, 2015)



Dynamics and impacts of university policies on the creation of spin-offs

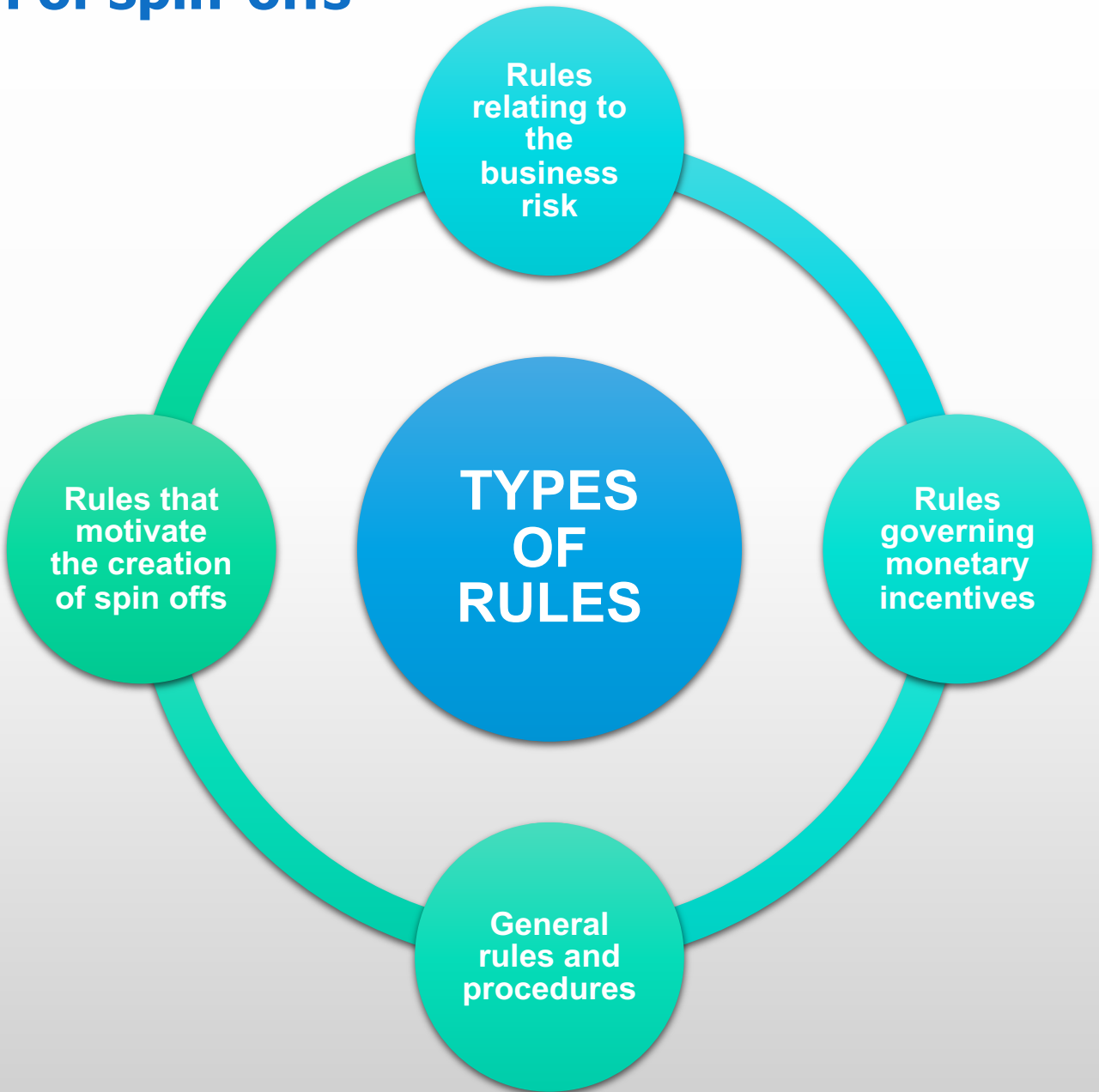
Internal complexity factors

- Individual factors
- Institutional factors
- Absence of a clear strategy from the university

(Van Looy et al., 2011)

External complexity factors

- Conditions of the socio-economic context
- Access to technologies, human and financial resources



Dynamics and impacts of university policies on the creation of spin-offs

(Muscio et al., 2014, 2016; Fini et al., 2017; Huyghe & Knockaert, 2016)

ENTREPRENEURIAL RISK

Reduce entrepreneurial risk

- Availability of access to laboratories and scientific incubators

Increase entrepreneurial risk

- Specific university rules.
- University exemption from risk

MONETARY INCENTIVES

Relevant factors	Fattori meno rilevanti
1. Incentives plan and risk sharing scheme	1. Reputation and recognition
2. Reward	2. Sensations
3. Distribution of royalty payments	3. Justice and fairness of rules and sharing

Comparison between academic and non-academic start-ups

- Colombo and Piva (2012): matched pair analysis between a sample of 64 Italian academic start-ups and a non-academic start-up control sample: significant differences related to:
  - **The human capital characteristics of the founders: the founders of this type of RBSO :**
    - They have more education and work experience in research;
    - Lack of industry-specific technical work experience;
    - They lack managerial and entrepreneurial experience;
    - Lack of commercial work experience similar to non-academic start-ups.
  - **Investment strategies: this type of RBSO shows:**
    - Increased research and development intensity;
    - Greater ability to attract qualified personnel (graduates) in technical functions;
    - Less propensity or ability to recruit managerial personnel.
  - **The strategies of alliance: this type of RBSO has :**
    - Greater propensity to establish collaborations with universities and public research centers and to participate in international collaborative research projects.

Management characteristics of the spin-offs

Spin-offs are usually managed by professors and researchers (Brennan et al., 2005)

POSITIVE ASPECTS

Academic entrepreneurs hold the intellectual capital associated with the new technology and have the essential scientific knowledge to improve the basic technology of the spin-off (Hayter, 2015)

NEGATIVE ASPECTS

Academic entrepreneurs often do not have the capacity and financial-managerial resources to convert a technology into a successful business (Parente et al, 2011; O'Shea et al, 2008)

Relevance of the negative characteristics of academic management

Managerial shortcomings and organizational skills
(Daniels and Hofer, 1993)

do not facilitate full exploitation of entrepreneurial potential(**Clarysse, *et al*, 2007)**

Excessive inclination and emphasis on the technical elements of innovation
(Iacobucci et al., 2011)

The management element and the focus on innovation entrepreneurial opportunities are omitted **(Radosevich, 1995)**

Reduced company performance

The managerial-entrepreneurial elements are the main obstacles to the development of spin-offs (Piccaluga, 2013)

Type of obstacles	Examples
Cultural	Limited personal goals Mistrust towards new skills (non-technical) and excessively "family" management Difficulties in managing change
Related to the corporate structure	Incomplete business team Difficulty attracting managerial figures Undeveloped administrative structure Little importance given to strategy, commercial development and internationalization Development of the discontinuous entrepreneurial team
Structural	Not innovative or non-proprietary technology Low investment in R&D Weakness of the business model Poor product-market connection Lack of financial resources and undercapitalization

Potential determinants of growth

Among the insights related to the factors that can determine the growth of spin-off companies, attention was dedicated, among others, to the *resource-based view* and to market strategies

- **The *Resource-Based View*** (cfr. Barney, 1991)
  - It focuses on the conditions / resources that exist at the time of incorporation of the company: Resources ⇒ Performance ⇒ Growth
  - The entrepreneur's challenge is to identify the key resources and to assemble them when they are set up
    - People (founding members) (cfr. Roberts, 1991; Shane & Stuart, 2002; Burton et al., 2002)
    - Product / Technology (cfr. Bollinger et al., 1983; Utterback et al., 1988)
    - Financial resources (cfr. Roberts, 1991; Hellmann & Puri, 2000; Manigart et al., 2002)
- **Market Strategy**
  - Focus (nicchia) Vs. diversification (expanding the target market) (Cooper et al., 1986; Romanelli, 1989; McDougall et al., 1994)
  - Local outlet market Vs. international and global outlet market since the establishment of the company(cfr. Oviatt & McDougall, 1994)

The role of initial resources

In international literature there are numerous empirical studies that have separately investigated the role played by different types of initial resources for the processes of creation and development of spin-off companies in public research, such as:

- the personal characteristics of the group of founding members (cfr. Roberts, 1991; Shane, 2001; Shane & Stuart, 2002; Burton *et al*., 2002)
  - technology (crf. Bollinger *et al.,* 1983; Utterback *et al*., 1988)
  - financial resources (cfr. Roberts, 1991; Manigart *et al*., 2002)

BUT…

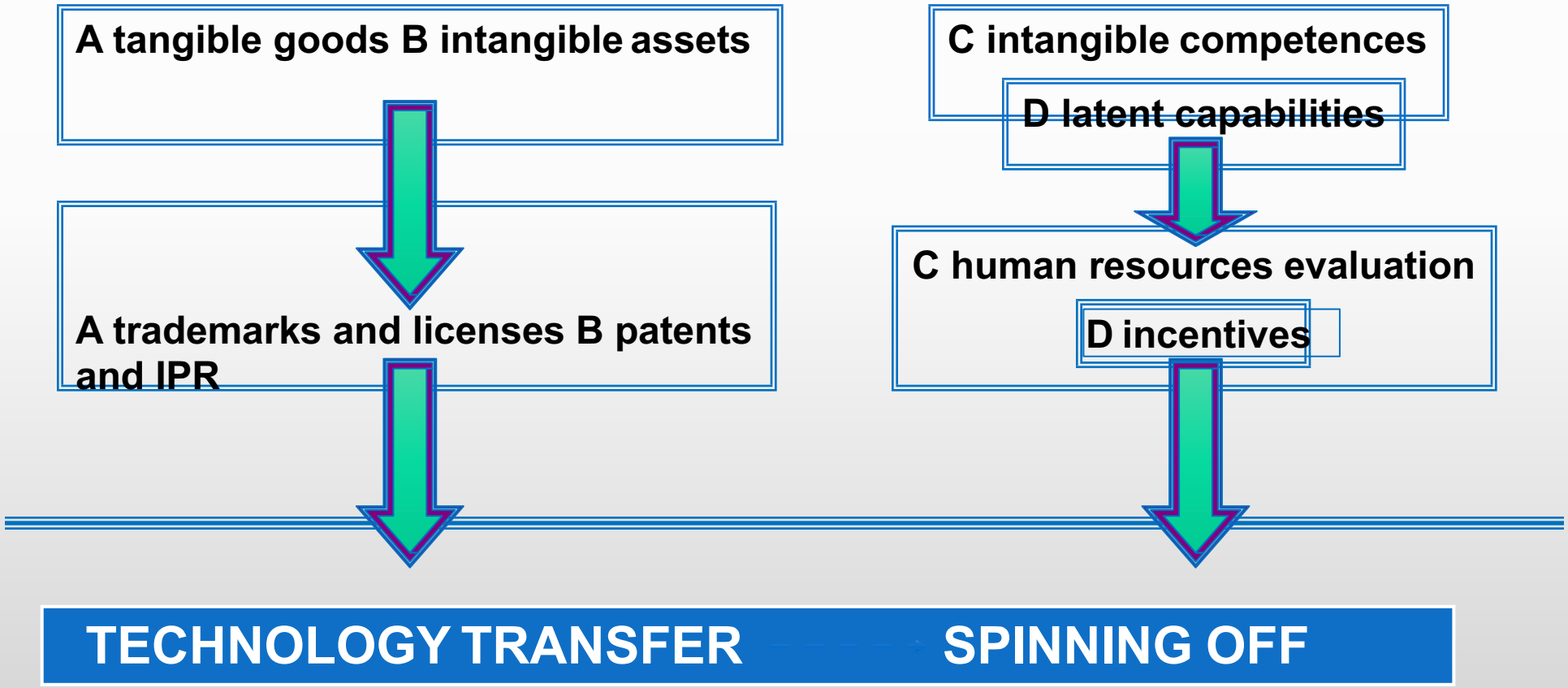
- resources are mutually connected and interconnected (crf. Roberts, 1992 ; Chandler & Hanks, 1998 ; Brush *et al.,* 2001)

- the result resulting from the availability of a resource also depends on the synergistic effects deriving from the relations between the latter and the other resources held by the company (cfr. Teece, 1986; Corner, 1991)

- in the existing literature the lack of an integrated approach in addressing the issue of initial resources available to public research spin-off companies is noted(cfr. Lee *et al.,* 2001)

Resources and economic exploitation strategy

There is a close connection between the availability of resources and the possibility of implementing exploitation tools (Rasmussen et al., 2014; Fernández-Alles et al., 2015)



Success elements: the role of the composition of the entrepreneurial team

Human capital is critical for the creation of value → access to personnel with specific knowledge and talent (Powers e McDougall, 2005; O'shea et al., 2005)

spin-offs are new, evolving companies that pass through different stages of development that require different resources and capacities (Vohora et al., 2004) → Team composition can have a significant impact on growth performance (Bjørnåli, e Gulbrandsen, 2010) → is able to successfully exploit the entrepreneurial potential of spin-off companies in the market (Filatotchev et al., 2006).

Identify team members who can bring complementary resources necessary for the development of the spin-off (Bjørnåli, e Gulbrandsen, 2010; Visintin and Pittino 2014):

- Identification of external members to the company and the university context;
- Introduction on the board of experts specializing in management and in counseling firm;
- Limitation in creating a team composed of subjects with similar characteristics and providing similar resources.

A model to increase the entrepreneurial orientation of spin-offs

Robert J.W. Tijssen (2006) in one of his studies he introduces the concepts, the theory, and a measurement model for the identification of the phases of entrepreneurial orientation within university contexts and within the framework of an analytical-quantitative framework.

The model consists of the following phases:

- **Phase 1: application-oriented/science-driven**
- **Phase 2: product oriented/utility-driven**
- **Phase 3: business oriented/market-driven**

A model to increase the entrepreneurial orientation of spin-offs

PHASE 1: APPLICATION-ORIENTED/SCIENCE-DRIVEN

- The direction of research activities acts as an institutionalized learning environment in an excellent R&D that precedes or coincides with a growing awareness of the possible links between research activities and business opportunities;
- Identification and recognition of the commercial potential of one's knowledge heritage concerning research;
- Links with (industrial) users and potential customers are expanded;
- The necessary skills are developed in the team or acquired from the outside.

A model to increase the entrepreneurial orientation of spin-offs

PHASE 2: PRODUCT ORIENTED/UTILITY-DRIVEN

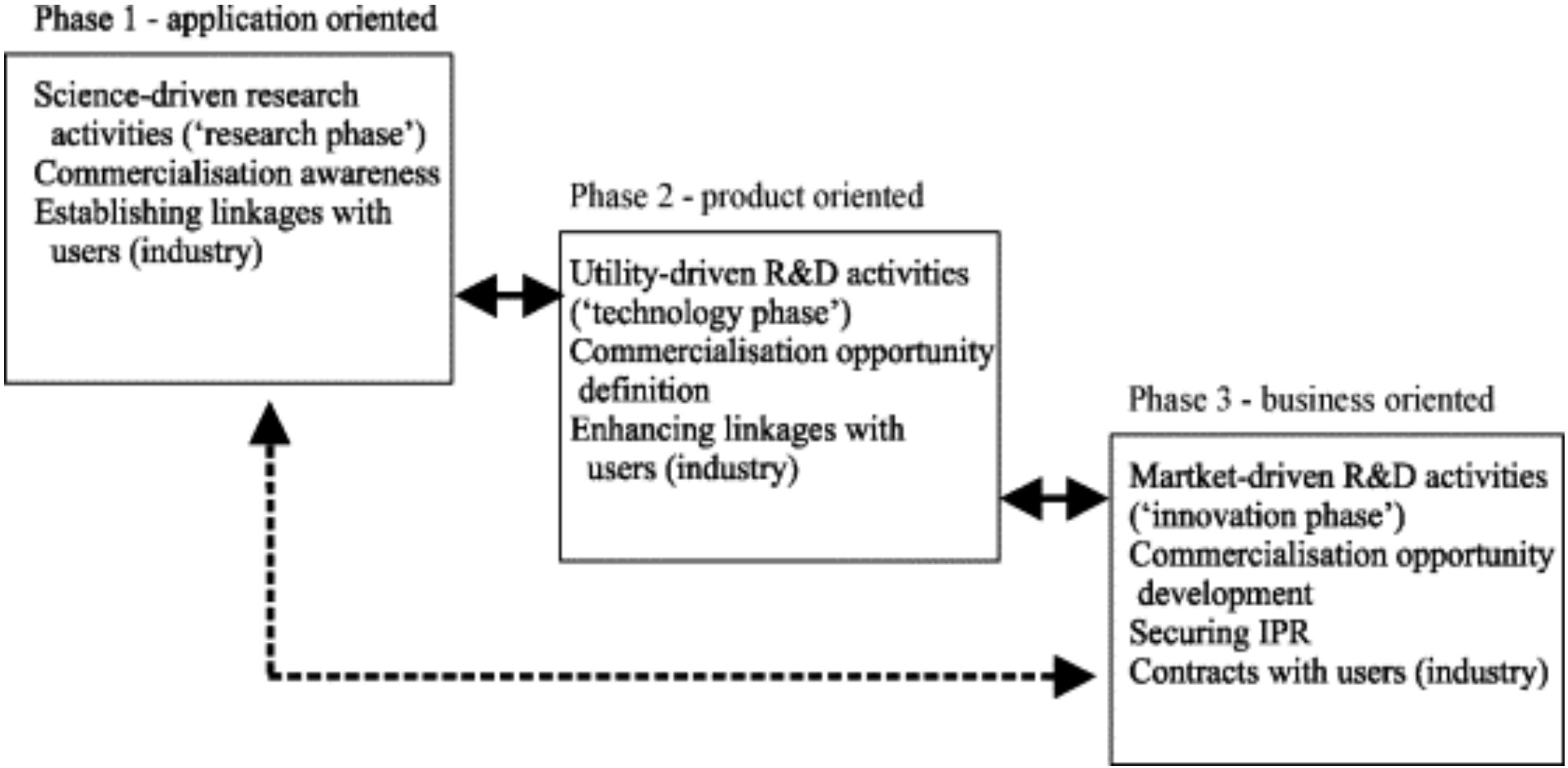
- regards the development of marketing opportunities → translation and development of tangible and tacit activities in the construction of the prototype, and services, technologies or products with exploitable economic value;
- The University becomes an entrepreneurial laboratory where it is possible to explore and improve the compatibility between activities and requests from (potential) users;
- managerial and organizational skills and a long-term articulated vision arise in order to create an entrepreneurial environment that ensures an ability to innovate in which new activities are created and existing activities are updated and translated into comparative advantages;
- Business ideas are developed;
- The support services offered by the industrial liaison offices and other specialized consultancy facilities located in science parks and business incubators, are sought and explored.

A model to increase the entrepreneurial orientation of spin-offs

PHASE 3: BUSINESS ORIENTED/MARKET-DRIVEN

- Intellectual property rights are protected;
- User contracts are created together with the associated transfer capabilities;
- The first services or products are sold, either through research contracts, consulting work, or otherwise;
- Market studies are conducted;
- The business plans are arranged and executed;
- University staff members are ready to become entrepreneurs (part-time or full-time).

The model of Robert J.W. Tijssen (2006)



Increase performance and innovation of spin-offs: the role of the university and the local external context

Supporting role of University - parent organization (O'Shea et al, 2007;. Rasmussen, Mosey, Wright, 2014)

Meso level (Muscio, 2010; Caiazza, 2014)

Dynamic Capabilities Approach (Teece, 2009) – ***Resource-Based View of the Firm*** (Sirmon et al., 2007)

- **Technology Transfer Office (TTO)**
- **University incubators & science parks**
- **Financial resources in R&D**

Dynamic forces and characteristics of the regional context (Sternberg, 2014; Varga, 2009; Siegel et al., 2007)

Macro level (O'shea et al., 2005; Wright, 2014)

Knowledge Spillover Theory of Entrepreneurship (Audretsch et al., 2006; Hellerstedt et al., 2014)

- **Regional R&D**
- **Regional human capital**
- **Region innovation level**

Supporting role of University – parent organization

Technology Transfer Office (TTO)

- The commercial resources provided by the TTOs have a complementary but significant role for the appropriation of research results and for the improvement of innovative activities in academic entrepreneurial activity (O'shea et al., 2005)
- TTO staff facilitates innovation and performance thanks to the advanced knowledge of technology and their marketing (Plewa et al., 2012) and the skills of TTO staff are fundamental to the spinout process(Wood, 2011).

University incubators & science parks

- They accelerate the exploitation of knowledge and technologies, offering advanced professional structures in the form of human capital, specialized skills, support infrastructures (Berbegal-Mirabent et al., 2015; Grimaldi & Grandi, 2005);
- They help the entrepreneur to overcome technical, managerial and market barriers for the full development of innovative spin-off activities (Vinig & Van Rijsbergen, 2010; Diez-Vial & Montoro-Sanchez, 2015).

Financial resources in R&D

The university research activity is fundamental in the successful performance of spin-offs, as increasing the volume of university research activities, the greater the volume of technology to be exploited, which is directly associated with university financial resources in R&D (Rodeiro-Pazos et al., 2012; Rodríguez-Gulías et al., 2015).

Dynamic forces and characteristics of the regional context

Regional R&D

- **External research and development activities can act as innovative inputs for spin-offs (Raspe & Van Oort, 2009), which can take advantage of the results obtained from regional R&D efforts.**
- **Dynamics related to the so-called spillover effect (Acs et al., 2013).**

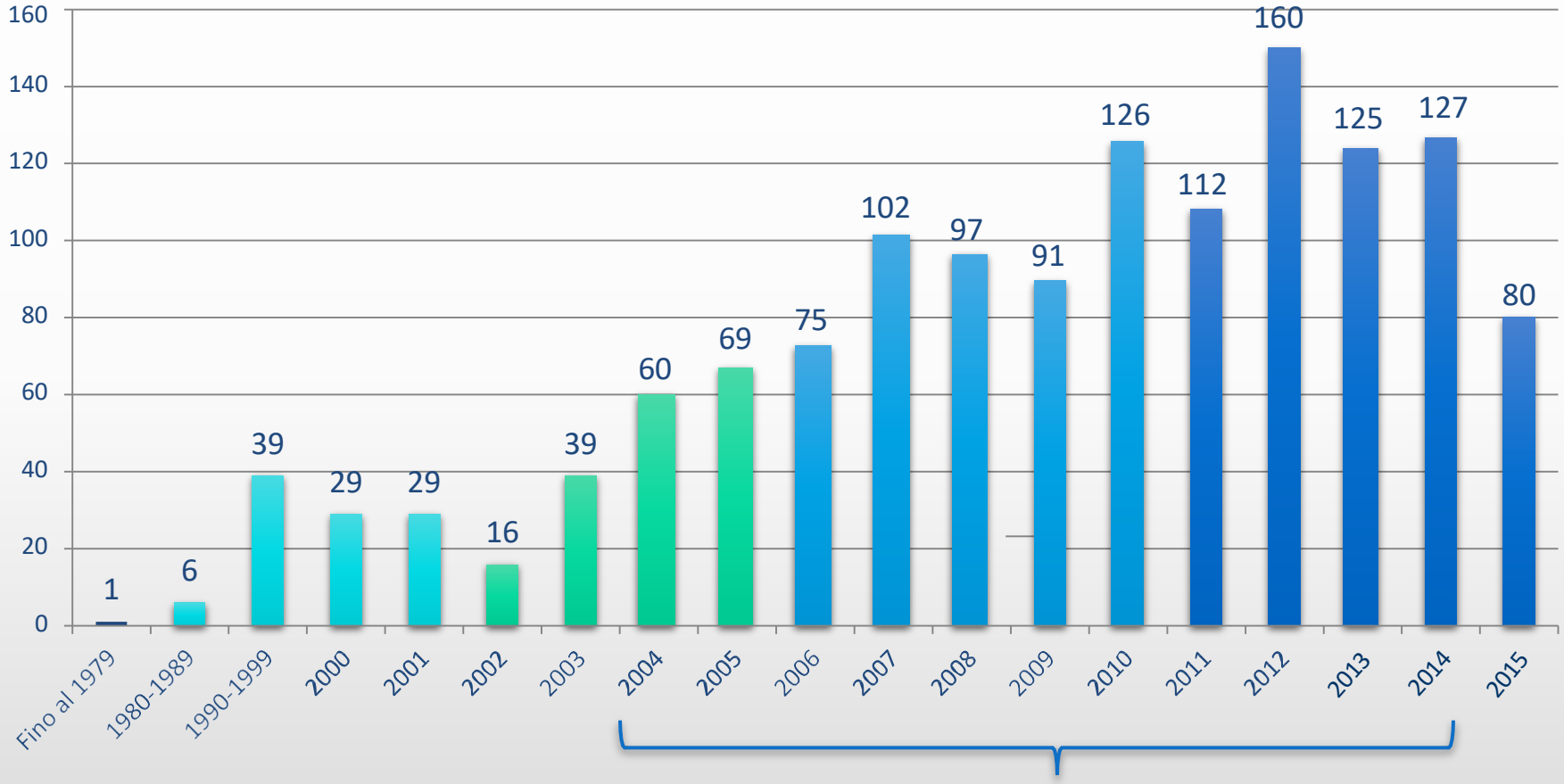
Regional human capital

- A workforce with an advanced educational-professional profile is more likely to absorb and use the knowledge and skills acquired, systematically managing the complex dynamics of the socio-economic system of the regional knowledge economy (Raspe & Van Oort, 2008; Audretsch & Feldman, 2004).

Region innovation level

The regional innovative activity, often in the form of a patent as an indicator of the cognitive-technological development of a region (Audretsch et al., 2008) can bring advantages to the entrepreneurial development of the intellectual property generated and therefore contribute to the effort innovative development of the spin-off (Van Oort & Raspe, 2009).

Number of active spin-offs by year of establishment (n=1,373) (Netval Report, 2018)



80% has been established in the last 10 years

Areas of activity of spin-off companies (n=1,373)
(Netval Report, 2018)

Business sectors	Number of companies	Percentage share	Average age (in years)
Electronics	68	5,0	12,4
Industrial automation	53	3,9	7,5
ICT	303	22,1	8,6
Biomedical	87	6,3	8,7
Nanotech	34	2,5	7,9
Aerospace	4	0,3	9,7
Energy and environment	229	16,7	6,7
Life sciences	210	15,3	6,5
Cultural heritage	22	1,6	7,6
Innovation services	363	26,4	4,8
Total spin-off companies as at 31.12.2015	**1.254**	**100,0**	**6,8**

Number of spin-off companies established annually at each university (n=69) (Netval Report, 2018)