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## **What role do universities play in the development of smart textiles in collaboration with small ventures? – The case of textile product innovation within equestrian sports**

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### **Abstract**

Title "The role of universities contribution of the development and application of smart textiles in equestrian sports" Name: Ida Hermanson Affiliation: Textilhögskolan Year of enrolment: 2015 Expected final date: 2020 Email: ida.hermansson@hb.se Abstract Existing state-of-the-art Technological innovation is complex, since it involves new markets and new technology, as well as collaboration between and inputs from a diverse set of actors (Chesbrough, 2006; Laage-Hellman & McKelvey, 2015). There is a growing body of literature exploring this complexity, for example Plewa et al. (2013) looks into the relationship of cross-sector collaborations and Alexander, Miller, and Fielding (2015) study activities that motivate entrepreneurial initiatives and knowledge transfer between universities and the industry. The research gap Smart textiles are textile products with integrated technology or functionality that can sense and respond to its environment (Berglin, 2013). Smart textiles are applied, for example, in health care and in the sport sector, however earlier research indicate barriers in the development process of smart textiles research projects. According to Garlinska and Röpert (2013) there are insufficient amount of publications that deals with "multidisciplinary know how" for smart textiles developers. Stoppa and Chiolerio (2014) suggest a multidisciplinary approach and that the development of smart textiles necessitates an integration of different knowledge basis. Researchers argue that the

development of new technology needs more support in the projects process and the planning for market introduction, which requires opportunity recognition, resources and financial capital (De Coster & Taib, 2015). The working research question for this paper is "The role of universities contribution of the development and application of smart textiles in equestrian sports" Theoretical arguments Emerging new technology within the development of medtech and sport products require an innovation network and integration of research, users and public policy (Chesbrough, 2006; Perkmann et al., 2013). To support the development of new technology universities have created structures for collaboration with different actors, which are supposed to give access to valuable resources (Perkmann et al., 2013). User knowledge and utilization of other external resources are suggested as important for small ventures as they often lack experiences and resources to innovate and commercialize innovations (De Coster & Taib, 2015; Keupp & Gassmann, 2013; Lee, Park, Park, & Yoon, 2010).

**Method** This paper is based on a case study of a university based sport and technology platform, applications and developments of smart textile products in equestrian sport. The data consist of interview transcripts, field notes from observation and document studies of newspaper, articles and press. This paper employs Nvivo as an analyzing tool for mapping and coding the data. **Results** The study shows that the university adopts unconventional strategies in their attempt to establish a platform for the development of commercial innovations within the sport and medtech sector. To succeed, the university must manage the complex task to organize a collaborative network that cut across groups of actors of which some have no previous experience of universities and triple helix settings. Findings from this case indicate that this platform act as a facilitator for innovation, however more resources and structure is needed for market introduction and entrepreneurial initiatives. **References** Alexander, A. T., Miller, K., & Fielding, S. (2015). Open for Business: Universities, Entrepreneurial Academics and Open Innovation. *International Journal of Innovation Management*, 19(06), 1540013. Berglin, L. (2013). Smart Textiles and Wearable Technology. Chesbrough, H. W. (2006). *Open innovation: the new imperative for creating and profiting from technology*. Boston, Mass: Harvard Business School Press. De Coster, R., & Taib, S. M. (2015). The Commercialisation of University Engineering Projects: Entrepreneurship Processes and Practices. *Competitive Strategies for Academic Entrepreneurship: Commercialization of Research-Based Products: Commercialization of Research-Based Products*, 70. Garlinska, A., & Röpert, A. (2013). Technology management and innovation strategies in the development of smart textiles. *Multidisciplinary Know-How for Smart-Textiles Developers*, 369. Keupp, M. M., & Gassmann, O. (2013). Resource constraints as triggers of radical innovation: Longitudinal evidence from the manufacturing sector. *Research policy*, 42(8), 1457. doi:10.1016/j.respol.2013.04.006 Laage-Hellman, J., & McKelvey, M. (2015). How Networks and Sectoral Conditions Affect Commercialization in a Knowledge Intensive Entrepreneurial Venture in the Medical Technology Industry: A case study of Aerocrine (pp. 265). Lee, S., Park, J., Park, G., & Yoon, B. (2010). Open innovation in SMEs—An intermediated network model. *Research policy*, 39(2), 290–300. doi:10.1016/j.respol.2009.12.009 Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., . . . Skolan för industriell teknik och, m. (2013). Academic engagement and commercialisation: A review of the literature on university–industry relations. *Research policy*, 42(2), 423–442. doi:10.1016/j.respol.2012.09.007 Plewa, C., Korff, N., Johnson, C., Macpherson, G., Baaken, T., & Rampersad, G. C. (2013). The evolution of university–industry linkages—A framework. *Journal of Engineering and Technology Management*, 30(1), 21–44. doi:10.1016/j.jengtecman.2012.11.005 Stoppa, M., & Chiolerio, A. (2014). Wearable electronics and smart textiles: a critical review. *Sensors*, 14(7), 11957–11992.

# The role of universities contribution of the development and application of smart textiles in equestrian sports

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## Introduction

Technological innovation is complex, since it involves new markets and new technology, as well as collaboration between and inputs from a diverse set of actors (Chesbrough, 2006; Laage-Hellman & McKelvey, 2015). There is a growing body of literature exploring this complexity, for example Plewa et al. (2013) looks into the relationship of cross-sector collaborations and Alexander, Miller, and Fielding (2015) study activities that motivate entrepreneurial initiatives and knowledge transfer between universities and the industry. Researchers argue that the development of new technology needs more support in the projects processes and the planning for market introduction, which requires opportunity recognition, resources and financial capital (De Coster & Taib, 2015). It has been suggested that emerging new technology within the development of sport products require an innovation network and integration of research, users and public policy (Chesbrough, 2006; Eriksson, Sandsjö, & Karlsson, 2014; McGreevy et al., 2013; Perkmann et al., 2013; Schwarz, Van Langenhove, Guermonprez, & Deguillemont, 2010). Sports are suggested to be multidisciplinary and innovation in this area is suggested to be complex due to e.g. acceptance of the users. Research about innovation management in the sports area is lacking (Ratten, 2016) and to support the development of new technology, universities have created structures for collaboration with different actors, and through the collaboration give access to valuable resources (Perkmann et al., 2013). User knowledge and utilization of other external resources are suggested as important for small ventures as they often lack experiences and resources to innovate and commercialize innovations (De Coster & Taib, 2015; Keupp & Gassmann, 2013; Lee, Park, Park, & Yoon, 2010). In this paper we explore the role of universities in cross sectorial collaboration with focus on the development of *smart textiles* by studying Chalmers Sport and Technology as a new type of innovation community that contribute to the establishment of new innovations through promotions of new resource combinations.

## Smart textiles

*Smart textiles* are textile products with integrated technology or functionality that can sense and respond to its environment (Berglin, 2013). Smart textiles are applied, for example, in health care and in the sport sector, however earlier research indicate barriers in the development process of smart textiles research projects (Dunne, 2010; McGreevy et al., 2013; Schwarz et al., 2010; Van Langenhove, 2007, 2015). According to Garlinska and Röpert (2013) there are insufficient amount of publications that deal with “multidisciplinary know how” for smart textiles developers and suggest that the development of smart textiles necessitates an integration of different resources (Berglin, 2013; Garlinska & Röpert, 2013). Challenges in the development of innovative textiles lie in a multidiscipline teamwork between different industries (Stoppa & Chiolerio, 2014; Van Langenhove, 2007). Hence, Eriksson et al. (2014) argue that it is important to combine different disciplines in order to receive experiences, share and gain knowledge within this field.

## Theoretical framework

### Resource combination

The *resource-based view* (RBV) is a widely utilized theoretical framework for explaining the increased university - industry interaction (Anatan, 2015; J. Barney, 1991; E. Penrose, 1959; van Rijnsoever, Hessels, & Vandeberg, 2008). In a RBV an organization can reach sustainable competitive advantage by accessing resources that are valuable, rare and difficult to replicate (Anatan, 2015; J. Barney, 1991; E. Penrose, 1959; Wiklund & Shepherd, 2009). Resources are argued to be heterogeneous (E. Penrose, 1959, p. 25) meaning that the same resource can be combined in different ways with other types of resources and hence provide a new set of products or services (Hjelmgren, 2005; Snehota, 1990). New combination of resources can create value when resources are combined across an organizations boundary (Alchian & Demsetz, 1972). These new combinations of resources may generate and stimulate different innovative outcomes and possibilities (Hjelmgren, 2005; Kostopoulos, Papalexandris, Papachroni, & Ioannou, 2011; Snehota, 1990; Teece, 1986; Wiklund & Shepherd, 2009). However, new combinations of resources involves uncertainty and it is argued that “the value of the resources is typically discovered as they are being combined” (see Denrell et al., 2003; Moran & Ghoshal, 1999 in Wiklund and Shepherd (2009, p. 196). Wiklund and Shepherd (2009, p. 196) refer to Galunic and Rodan (1998, p. 1195), arguing that resource combinations involves “how the knowledge embedded within a competence

may have to be untangled, altered, and integrated with other knowledge bases to create novel business concepts and/or competencies”.

Earlier research has systematically divided resources into different categories. There are different views of how to categorize different resources, either as tangible (e.g. physical infrastructure, equipment and materials), intangible (intellectual property, brand and culture), human capital (e.g., staff and associates) (Philbin, 2012; Wernerfelt, 1984) or financial, physical, human capital and organizational (J. B. Barney, 1997; Powers & McDougall, 2005). Scholars have also classified relationships as a resource (Håkansson & Ford, 2002) since it facilitates transfer and exchange of resources between actors and organizations and are considered as important places for resource combination. A resource that has been identified to be crucial and primary but difficult to transfer is *tacit knowledge* (Polanyi, 1967) as it is hard to imitate and absorb, also known as “sticky” (Anatan, 2015; J. Barney, 1991; Cohen & Levinthal, 1990; E. T. Penrose, 1995; von Hippel, 1994; Wernerfelt, 1984). Established collaborations between universities and industries in *strategic alliances* (Etzkowitz & Leydesdorff, 2000) can help actors and organizations mobilize possibilities to combine, utilize others knowledge and exchange valuable, complementary resources for a shared objective. This type of interaction could have a positive outcome of an organization competitive advantage and decision-making (Anatan, 2015, p. 714c.f ; Eisenhardt & Schoonhoven, 1996; Kogut, 1988; Lyles & Salk, 1996).

### **Collaboration in community of practice**

Research and practice has shown that collaboration between heterogeneous actors may facilitate innovation processes, but how to design and arrange an efficient collaboration between actors from different disciplines remains unclear (Sandberg, Holmström, Napier, & Levén, 2015, p. 44). Collaboration between actors is a form of networks that involves exchange of knowledge and can be referred to a *community of practice* that consists of mutual engagement, established rules, rituals as well as artifacts and symbols that are commonly understood (van Rijnsoever et al., 2008; E. Wenger, 1998, p. 6). Mutual engagement in community of practice helps participants to discover what defines their indent, whom to collaborate with and what helps and hinders different activities (E. Wenger, 1998, p. 6 & p 95). People in community of practice share experiences and ideas which may foster ways of problem solving, learning and innovation (Pattinson & Preece, 2014; E. C. Wenger & Snyder,

2000). In communities of practice exchange of knowledge and information can be achieved through and *boundary spanning*, *trading zones* and *boundary objects*

### **Boundary spanning**

Taheri and van Geenhuizen (2016) argue that universities focus much more on commercialization of knowledge and problem solving than earlier. Today, universities seem to adopt a more open science, such as additional interactive relationship with the general public, society and users (Taheri & van Geenhuizen, 2016). This in order to promote collaboration, creativity and make science more accessible to the general public through different tools such as media and network (Taheri & van Geenhuizen, 2016, p. 32). Commercialization of knowledge, as making knowledge accessible to a broader public, universities need to build "bridges" to different worlds, such as between universities and science, business and user groups (Taheri & van Geenhuizen, 2016, p. 32). This type of activities includes boundary spanning. Scholars have pointed out recommendation for boundary spanning activities for facilitate and negotiate transfer of knowledge and technology (Katz & Tushman, 1983; Siegel, Waldman, Atwater, & Link, 2003). However, there exists little awareness of the benefits of boundary spanning activities in university settings (Taheri & van Geenhuizen, 2016).

Studies applying boundary spanning searching for more understanding of how collaboration in projects between individuals and organizations is accomplished (Noble & Jones, 2006).

Actors in a firm or an organization can access resources across a organization boundaries (Schweisfurth & Herstatt, 2016, p. 109). Such actors are called *boundary spanners*, as they link the external environment with the organization, can transfer and build relationships, and gather information about complex problems and collaborations (Schweisfurth & Herstatt, 2016). These boundary spanners, described in earlier research, as actors of different forms and motives such as ambassadorship, coordination, intermediaries, project leaders and supervisors, external representation as well as strategic alliances, collaborative activities, learning, problem solving, sharing of information's (research) as well as gain valuable information for innovation (Comacchio, Bonesso, & Pizzi, 2012, p. 948; Katz & Tushman, 1983; McEvily & Marcus, 2005; Schweisfurth & Herstatt, 2016; Taheri & van Geenhuizen, 2016, pp. 32-33; Tushman & Scanlan, 1981). Boundary spanners are argued to be key actors in information processes activities as they can improve multi-institutional technology projects

as well as project members through coaching and clear relationships with other disciplines (Comacchio et al., 2012, p. 948; Corley, Boardman, & Bozeman, 2006; Fleming & Waguespack, 2007; Greitzer, Pertuze, Calder, & Lucas, 2010; Katz & Tushman, 1983, p. 439). A boundary spanner could for example be a researcher shaping new research horizons by linking science, businesses and organizations (Casati & Genet, 2014; Taheri & van Geenhuizen, 2016, p. 33). However, scholars has pointed out that to be able to learn from the external knowledge and transfer it internally individuals need to "speak the languages of the both domains they span" (e.g. Tushman & Scanlan 1981 in Schweisfurth and Herstatt (2016, p. 109). Scholars have identified boundary spanning as a facilitator for interactions between different worlds as it involves network building and collaborative learning (Katz & Tushman, 1983, p. 439; Taheri & van Geenhuizen, 2016). Boundary spanning can activate direct contacts among unrelated actors and organizations as well as coordinate a language model that corresponds to other firms and organizations communication codes (Carlile, 2004). Koruna (2004) refers to Allen (1986) and argues that boundary spanners may affect resource combination as it combine resources inside the organization with external. This skill requires absorptive capacity, which refers to 'ability to recognize the value of new information, assimilate it, and apply it to commercial ends,' (Cohen & Levinthal, 1990, p. 128; Koruna, 2004). The knowledge that is generated in the collaboration between university-industry interactions needs to be transferred, translated and transformed into practical, commercially viable solutions (Carlile, 2004; Sandberg et al., 2015, p. 45). Boundary spanning activities within university-industry interactions often differs from other types of collaborations, as it is involves complexity and often depends on attracting external resources and the activities are also expected to go further than just scientific publications (Adler, Elmquist, & Norrgren, 2009). As argued by Adler et al. (2009), this type of research initiative are not a part of a academic organization when it comes to the financial structure, since the funding often is shorter than the actual research activities, additional external funding is often necessary and the initiative is often dependent on internal university resources, which is outside the boundary spanners control. Boundary spanning research activities is also complex du to the expectation of generating economic value in forms of methods and tools at the same time as coordinate and guide actors from different disciplines (e.g. Starkey & Tiratsoo 2007 in (Adler et al., 2009).

### Trading zones and boundary objects

A larger degree of diversity may promote innovation but it requires a high level of commitment from network participants (Sandberg et al., 2015). Sandberg et al. (2015) study focus on university-industry collaboration and identifies different *trading zones*. In trading zones actors can interact and exchange resources across boundaries and overcome difficulties, despite dissimilarities in background, language and culture (Kellogg, Orlikowski, & Yates, 2006; Sandberg et al., 2015). Trading zones are supported by boundary objects and individuals that can “hold or acquire knowledge of the involved cultures and, to some degree, mediate differences” (Sandberg et al., 2015, p. 49) as well as “match actors and translate problem comprehension and abstract competencies”(Sandberg et al., 2015, p. 54).

Boundary object may facilitate cross-disciplinary collaboration and build bridges between different actors and are defined as objects that may be abstract or physical, that has different meanings in different worlds and may overstate difficulties in communications in collaboration between different actors (Sandberg et al., 2015; E. Wenger, 1998). Example of boundary objects are sketches and drawings, prototypes, physical and IT objects, processes and methods, business models, field notes, maps, terms, concepts material and facilities (e.g. Carlile, 2002; Nicolini, Mengis, & Swan, 2012, p. 616; Sandberg et al., 2015; Sanz-Velasco & Saemundsson, 2008; Star & Griesemer, 1989; E. Wenger, 1998, p. 105). Boundary spanning, trading zones and boundary objects act as tools for understanding collaboration between actors with different background and motives, e.g. in collaboration between universities and companies. In addition, these tools are important for the development products and innovations that require different competences and resources that have not earlier been brought together.

### Method

This paper is based on a case study of a university based sport and technology platform, applications and developments of smart textile products in equestrian sport. The data consist of semi structured interviews transcripts with four individuals at Chalmers University. Additional data is collected from field notes from participatory observations of workshops, seminars, lectures and events. Observing activities that takes place enhance the understanding of the activities and interaction as well as dialogs and discussion between a diverse set of actors (Merriam & Tisdell, 2015). Direct engagement in social contexts helped me to explore the interaction between structure, action and “how people are embedded in larger social and cultural contexts and how, in turn, they actively participate in shaping the worlds they



inhabit” (May, 2002, p. 182). Further data was collected from newspapers, articles, brochures and press published between 2011-2016. As suggested by Czarniawska (2014) major element of media can be accessed via the cyberspace, such as social media to access events that are organized by the community’s Facebook webpage and website. Web-based documents, newspaper, journals and websites were collected to access additional interviews, information and perception of the development of the university based sport and technology platform. NVivo has been applied as an analyzing tool for mapping and coding the data. This strategy was chosen to be able to analyze a larger set of text (Silverman, 2013). The coding was based on an inductive approach after the empirical concepts *actors*, *activities* and *resources*.

### **The Case of Chalmers Sport and Technology – Equestrian Sport**

The initiative Chalmers Sport and technology is a platform at a Swedish technological university where athletes, coaches, companies, public organizations and the general public can meet researchers and students to adopt advanced sport related research in equestrian sport. The initiative to Chalmers sport and technology within equestrian sport started around the year 2012 when two researchers at Chalmers and GU, with academic background in physics, discovered that they could apply for research grants for horses welfare and have since then been engaging and establishing different activities to develop this initiative.

Around 2011 2012...somewhere... Karl and I started to talk about if we could do something since...since we had noticed announcement where you could apply for grants within equestrian sport...I have experiences of horses since I was nine years old...it has always been a hobby, nothing that I have been working with...and then Karl said that he had begun to work with smart textiles so then we thought about it a little bit of how we could use it...somewhere there it all started (Jenny)

As shown in the quote above, one of the researchers, a senior lecture in astrophysics, had a passion for equestrian sport and the other researcher, senior lecture in physics, had newly started a new project in smart textiles together with a researcher from the Swedish School of textiles. Through technological solutions Chalmers Sport and technology has since 2012 started to develop materials, measuring instruments and methods, for example integrating smart textiles in horse equipment’s such as horse blankets, girths and bandages.

Technological expertise is integrated in a field that traditionally is dominated by biological and veterinary research.

We met a need there...equine science in Sweden is really good, international successful but it only corresponds within veterinary medicine and biology so we came with new methods, new ways of thinking, new ways of measuring that they saw benefits of and at the same time we were not competitors... so we were well received (Jenny)

For example, in 2012 researchers at Chalmers and GU send a physics student to Australia to establish collaboration with veterinary researchers at Sydney University and equine behaviorists at Australian Equine Behavior Centre (AEBC) to develop a smart textile sensor that could measure EKG on horses. This collaboration focused on measuring with technology and studies of how equestrian equipment influences the horse. In Australia this student could work in a stable with researchers and horses and test how to measure EKG on a horse with a smart textile.

I was in a stable, they had small lab in this stable, but it was very far from the world of Chalmers ...much more like a stable. Like...well there was no measurement equipment so I had to build one on my own..very fun but anyway...quite soon...I received a good signal from the horse...which was fun because I think that was the first time someone had been able to measure something on a horse with smart textiles..." (Malin)

This research resulted in new insights, which later on led to a publication written by this student, researchers at Chalmers, GU, University of Sydney and AEBC and a presentation at International Society for Equitation Science (ISES) conference in Delaware in USA 2013. Through the years interdisciplinary research has been conducted on different levels (undergraduate and graduate students) and different areas (not only smart textiles) supervised by the initiators as well as between established researchers and between university and industry. Originally, due to lack of resources many projects have started at a student level.

...there is almost always a student in every projects we have...we have always a thesis job or a group of undergraduates that are researching...(Karl)

...they can be interested in horses or not...so they have different perspectives, but this is a very good way starting up, if we have had an idea of what we could do or if we receive something

externally, undergraduates or a thesis job could work with it for a while , in that way we can get a sense of the substance that we can continue working with later...(Jenny)

Most of the student driven projects at Chalmers in Chalmers Sport and technology project catalogue often call for students that have experiences of horses.

we have many students that are interested in equestrian sports here at Chalmers, and at other universities that comes...and for them it is a joy to be able to work with horses ...and to be able to work with something that you are interested in often makes things much better (Jenny)

One example of university-industry collaboration was conducted in 2016 between a university spin off PressCise, engineering students at Chalmers, researching veterinaries at Swedish University of Agricultural Sciences (SLU), and researchers in functional materials at Uppsala University. This was a student-driven project of development and production of a smart bandage for treatment of rasp where a group of six students conducted business plan, requirement specification, and a survey for horse owners, product development, lab tests and contact stable and horse owners to plan and to conduct tests on horses.

Chalmers Sport and technology organize dynamic meeting places for scientists and the general public. One special meeting point is a social event called “Horse cafes” which are workshops, seminars and lectures where the general public, athletes, coaches, companies, and public organizations can attend to discuss sport related problems that can be solved with technology. The main purpose for these cafe’s are to distribute research and knowledge to individuals that does not normally encounter the possibilities of technology research in equestrian sport, for example student projects and general equine science. Additionally, also to establish contacts with riders and horse owner as well as find out more about problems that this group experience that could be possible to integrate in research projects. Participants also include international and domestic sport organizations such as Fédération Équestre Internationale (FEI) which is the international solitary controlling authority for international events in equestrian sports (FEI, 2016) and The Swedish Equestrian Federation, an non-profit organization that promote and develop Swedish equestrian sport and relate its operation nationally and internationally, a member in The Swedish Sports Confederation as well as in FEI. Represent equestrian sport against authorities, politicians and society and work forward to creating discussions about future developments, act for good horsemanship and horse

keeping and argues for the contribution of equestrian sport in public welfare (Ridsportförbundet, 2012-2013). The main interests from these actors are the possibilities to integrate technology in equestrian sport to be able to "read" and understand horses better and to live up to the core value – horses as "happy athletes" (FEI, 29 Oct 2004). Other organizations participating are riding clubs and riding schools as well as actors such stable owners, farriers, veterinarians, breeders, athlete equestrians, hobbyist, coaches, dressage judges, equestrian equipment's companies and equestrian events organizations. Several other companies in different industry fields participate in these workshops, seminars and conferences from 2012-2016. The original focus in Chalmers Sport and technology has been to collect so called "problems" from users, the general public and stable owners within the equestrian sport and the aim has been to conduct interesting research. One of the initiators to equestrian sport technology at Chalmers Sport and technology talked during a horse café in December 2016 how they work with technology and research. At Chalmers Sport and technology they work with already existing technology and by asking equestrians "how can we use this" they receive a lot of ideas that is fundamental for research, innovations and companies. The research that is conducted generates new ideas, solve problems and also finding new applications for already existing technology or exploit something new. According to the researchers that held this presentation, it is a win-win situation as the research result generates further research.

Smaller and larger firms within the high tech, medtech, car industry, health industry, equestrian equipment producers and other such as producers, suppliers, entrepreneurs and retailers are other actors identified as participants at these horse cafes and other events. Public and business organization, contribute with competences in contacts, business development and innovation in the initiative Chalmers Sport and technology are Connect väst, Smart textiles, innovation offices such as Incubator and Swerea IF. Grants and funding has been increasing over the years, from 2012 -2016. Public organizations that have been contributing with financial capital are Västra Götalandsregionen, Sting, Vinnova, and Chalmers. The development of products depends on the access to resources, for example:

we do not have enough resources to work with it for a half a year and think of something...students that wants to write a thesis...suits really well (Jenny)

...it is the same thing, we would need a PhD, or at least a master student or someone that could

continue working with it...to make a working product, can we do that...then we have interesting research questions that we can explore with support by this product...if we could make it work...more people (Karl)

...resources, it is our time ...postdocs...(Jenny)

These “horse cafes” have different themes for attracting a diverse set of audience. In march 2014 researchers at Chalmers area of advance - Material, Smart textiles at Swedish school of textiles, School of sport science at GU and Västsvenska Idrottsförbundet arranged a mini-conference on smart textiles for example companies, athletes, horse owners, researches, hobbyist, students and sport organizations. Researchers from Swedish School of textiles talked about the potential of smart textile in sports in general, but also in equine sports. At another horse café in December 2016 with the theme “Dressage”, one event company “Dressage Power” established by two dressage enthusiast and well experienced athletes announced wishes and ideas of how to integrate smart textiles in different horse equipment such as saddle pads, boots and riding clothes, this in order to create tools for better interaction between coaches, riders and horses.

The interaction with the general public, athletes, coaches and public organizations is also conducted through participating in bigger fairs and horse competition. From 2013, the equestrian Chalmers Sport and technology have been participating in one of largest horse events in Sweden, Gothenburg Horse Show. In connection to Gothenburg Horse show there is a big exhibition hall where the initiators to Chalmers sport and technology equine center originally joined this to see what type of contacts that could be established through this forum.

(Karl)..it has developed as a fun idea we had...2013 maybe...(Jenny)..yes, the first time we went there was just because we had begun with this equine science and it was fun to be there, to see what types of contacts we could get...so together with some happy volunteers we build this show case and had some students with us...and it has looked like that until this year (2016)

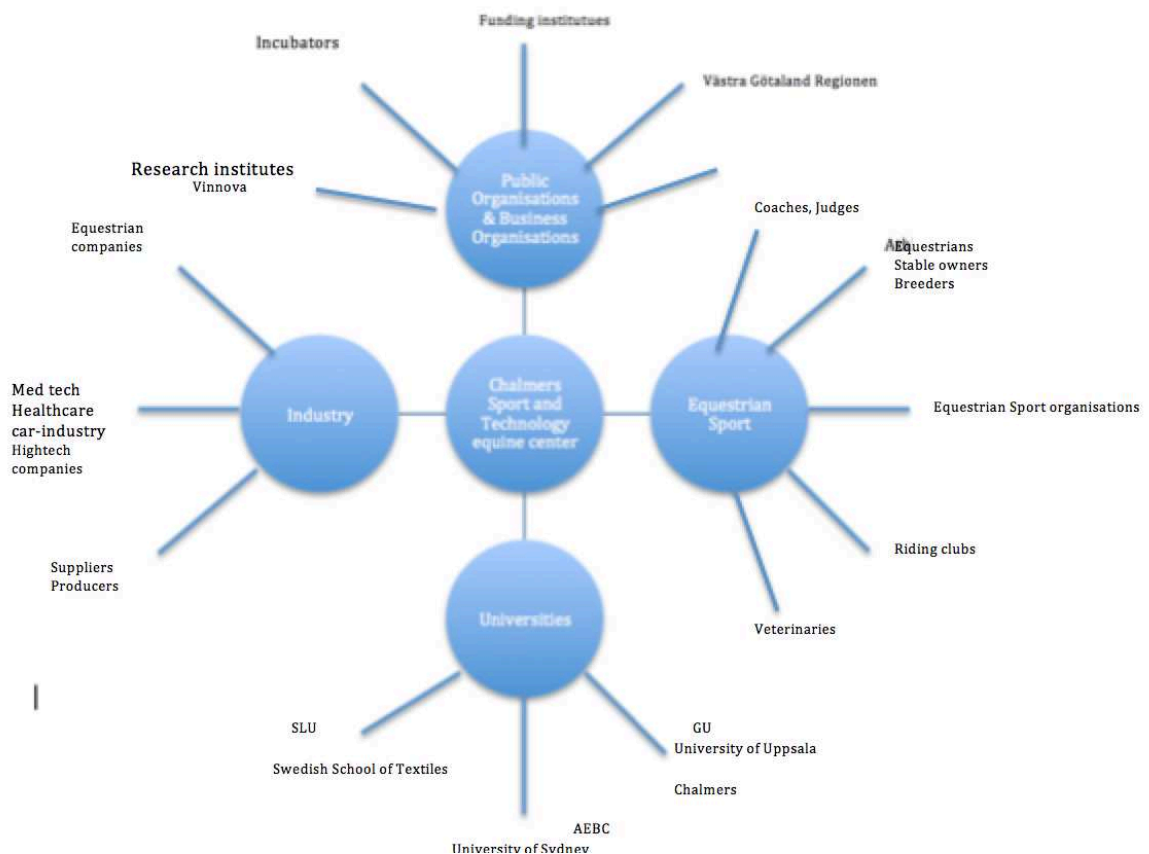
In 2016 Chalmers invested more money to advertise Chalmers University during Gothenburg Horse Show as a sport university to show future students and their parents the possibilities to combine technology studies and horses. This year they also had “speakers stage” where researchers, students and companies presented their projects and products for the general

public. Three of the presentations were related to smart textiles for example smart bandages, interactive riding vest and how to measure EKG on horses, where the latter were presented by the student who went to Australia and collaborated with veterinary research at University of Sydney and equine behaviorists at AEBC. This student and project has become the student representative for Chalmers Sport and Technology equine center, a project that shows how to combine technology studies and horses.

“to pass on research, pass on knowledge and to people that normally does not study or work here...and this is an important part from many areas to...like...to reach people that normally does not encounter technology daily...to get a sense of what is going on..what you can do..., like general level of education...and it is good PR as well”

## Discussion

Chalmers sport and technology shows a complex network that contains of a diverse set of actors, organizations and universities as illustrated in the “working” model below. It demonstrates an open network and promotion of making knowledge accessible to a broader public (Taheri & van Geenhuizen, 2016).



The management of a complex network Chalmers sport and technology is identified as a trading zone where actors and resources meet to undertake activities to negotiate, promote and facilitate innovation (Sandberg et al., 2015). Through different activities such as the “horse-café”, interdisciplinary research and participation at larger horse events Chalmers Sport and Technology manage to create interest, establish contacts and attract a larger number of different actors with different competences and resources. Boundary objects, such as the horse facilitate the transfer of information and communication (E. Wenger, 1998). The horse, as an object, becomes a common meeting point as many of the actors that are engaging in Chalmers Sport and Technology share the same mutual engagement and interest for horses. The horse brings together different actors with competences and resources and facilitates the interaction between a diverse set of actors despite different corporate area, preferences and background (Adler et al., 2009). The horse, as an object, act as a tool for finding new application areas for already existing technology or new ways of using and applying smart textiles. Except boundary objects, such as the horse, boundary spanners play a key role in the support of putting together competences and resources. One of the initiators to Chalmers Sport and Technology equine center has a passion and experiences of horses since the age of nine and a long carrier of research within physics. The ability to absorb and combine these to elements makes it possible to for this boundary spanner to transfer problems and resources into the academic world as she knows and understand the equestrian domain (Cohen & Levinthal, 1990; Sandberg et al., 2015; Taheri & van Geenhuizen, 2016). Together with other researchers they perform boundary spanning activities, locating resources outside their own organization, open up technological science to the general public and companies which then have led to the creation of new types of collaborations and research projects on different levels as well as access to funding and grants (Adler et al., 2009; Katz & Tushman, 1983; Koruna, 2004; Taheri & van Geenhuizen, 2016). One example of this type of activity is the EKG project that was conducted through interdisciplinary research, where different disciplinary knowledge of the horse has generated new insights and perspectives of how to work with smart textiles and horses. By engaging and participating in different activities these boundary spanners administer and supervise transfer of experiences and match competences from different project into new projects as well as create new research areas (Sandberg et al., 2015). The activities and mutual engagement between actors have enabled new ways of combine resources and therefor contributed to foster innovation (Pattinson & Preece, 2014; E.

C. Wenger & Snyder, 2000). However, more external and long term resources is needed for commercialization of research results which corresponds to the argument that there exist a complexity in the management of a diverse set of actors and activities (Adler et al., 2009).

## Conclusion

Powers and McDougall (2005, p. 296) state that earlier research has found positive relationships between university research, innovations, collaborations with high technology industries and creations of new companies as it enable actors to access valuable resources and enable resource combination in research and projects (Wirsih, Kock, Strumann, & Schultz, 2016). The study shows that researchers at the university adopt unconventional strategies in their attempt to establish a platform for the development of smart textile innovations within the equestrian sport. To succeed, the university must manage the complex task to organize a collaborative network that cut across groups of actors of which some have no previous experience of universities and triple helix settings (Etzkowitz & Leydesdorff, 2000). The case has shown that Chalmers Sport and technology has several trading zones for facilitating innovation in cross sector collaborations, which relates to studies conducted by for example Berglin (2013) and Stoppa and Chiolerio (2014), that development of smart textiles requires multidisciplinary collaboration and integration of different resources. The case of Chalmers Sport and Technology indicates that the role of the university and the activities that is conducted increase the awareness and generates ideas of how to integrate smart textiles in different equestrian equipment. Findings from this case indicates that this platform act as a facilitator for innovation and shows indications of being an so called *performative trading zone*, where focus is on exploitation, absorptive capacity, and exchange of boundary objects that does not require any close relationships (Sandberg et al., 2015). The successful character of Chalmers Sport and technology may depend of the regular exchange of resources in the arrangement of forums for interaction and collaborative projects on boundary objects, which have shown as an proactive tool for promote informal collaborations towards innovations in university-industry settings (Sandberg et al., 2015, p. 62). Additionally, this type of cross sector collaboration between expertise in for example technology, veterinary researchers and equine behaviorists correspond well to arguments of outcomes and reasons for collaboration, such as access to knowledge, problem solving, engaging students, company's, public organizations an users in a fun and new way (van Rijnsoever et al., 2008). This study has contributed to new insights for how initiative as Chalmers Sport and Technology contribute to



new innovations through actively in different ways promote combinations of resources from unrelated sources (Carlile, 2004). However, the tentative result shows more resources and structure are needed for market introduction and entrepreneurial initiatives (De Coster & Taib, 2015; Ratten, 2016).

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