Managerial Challenges in Intellectual Property Rights Control in Open Educational Settings: Perspectives from Management Literatures

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***Abstract*-Universities have introduced new experiential courses in curriculum offerings as a response to a perceived lack of practical marketing and design experience for students. Although being true in spirit to their predecessors originating from leading educational institutions, the established design-and-entrepreneurship mixed education model elsewhere have only recently raised heightened attention in Taiwan, and questions are growing mostly as to address how to best align students and third-parties' interests with institutional policies to appropriately reflect their non-employment status, lack of engagement in the business of conducting university-sponsored research as with faculty and graduate students. This article continues the author's previous investigation describing the managerial needs in an engineering design course setting in Taiwan. Building on previous research assuming a process approach to consider student's legally debatable behavioral conducts, current article proceeds further to analyze the context under which behavioral conducts can lead to intellectual property ownership disputes. A case study with an ethnographic approach is used to collect data and an archival survey of official university documents and relevant cultural contexts are used to make sense of student behaviors and the unique challenge in managing IP conceived from an open student entrepreneurial course.**

I. INTRODUCTION

Scholarly attention to experiential education program (hereinafter EEP for simplicity), which this study defines as a learning program for educating both the means and processes for implementing new product development and product marketing, has increased thanks in part of growing popular recognition for its practical significance [1][2]. EEP is now more critical at least for driving growth because its role and function work out to provide at least three benefits: (a) responding industrial needs for workplace-ready talents, (b) encouraging start-up companies' survival rates, and (c) providing universities with a fast track option to become more entrepreneurial either for their own growth or for strengthening its contribution to the quality of national innovation system.

But with much emphasis on creating economic and social values through this non-traditional model of knowledge transfer from the academe to the industry, research suggests that in order for producers to be awarded with incentives and drives to maintain inventive labors, it should be understood that there is also a need for equal consideration on capturing those values, in particular ensuring the inventive ideas get to be materialized by ways of start-up company creation or product sales through proper appropriability mechanisms. Indeed, scholarly research shows that appropriability mechanism is important because it provides a public infrastructure for original inventors to protect investment in innovative activities [3], and earmark the profits to the rightful source of knowledge embodied in the inventive process under the knowledge transfer context [4]. Furthermore, literatures covering the role of appropriabilty mechanism on either industrial level or academic level have informed policy makers and inventors of the importance of intellectual property ownership as a fundamental tool to govern knowledge outputs [5]. However, despite increased attention for protecting legal rights to claim ownership of intellectual property, much research done in the context of a university environment has focused on staff members: faculty members, graduate students employed on research contracts, staff technicians. Limited research has systematically examined what and how non-staff students' behaviors (defined in this study as individuals taking part of an educational program as audience of instruction; they pay fees for access to learning materials, and enjoy the rights to consult instructors for direction and best practices to proceed with their inventing objectives) in their inventive endeavors within EEPs may be inductive to intellectual property ownership disputes. This paper aims to report an empirical finding that focuses on how actions undertaken during non-staff students' collaboration and use of university resources give rise to intellectual property ownership disputes, an issue critical for effective valorization of knowledge transfer.

Following [6], this study's purpose is to explore the university governance on student-generated intellectual property, focusing particularly on boundary-less EEP environment previously examined in [7]. [7] pinpointed observed student behaviors in relevance to resource-seeking and collaboration in a university EEP that simulates 6 sequential stages common in an industrial product innovation process: (1) creativity and ideation, (2) open innovation, (3) design thinking, (4) agile software, (5) lean startup, (6) business model canvas. My objective in this exploratory study is to attempt to examine these behaviors from the perspective of intellectual property ownership by investigating why and how may the non-employment status of non-staff students working within an EEP environment relate to behaviors recognized by the law to be debatable in the matter of intellectual property ownership. To this end, I apply a case study approach to answer the research question: "Why and how does non-employment status engender student's collaborative and university-resource–accessing behaviors to cause IP ownership disputes arising from an open-ended EEP?"

The remainder of this paper is structured as follows. First, I will review relevant literatures to develop conceptual

understandings regarding the role of EEP under current societal context, and the respective design elements in its administration. I also review for the emerging recognizance for the value of student-generated intellectual property. In particular the focus is on its generation from EEP. Second, I will discuss an examplar case of an EEP as the subject of this study, whose learning environment is designed based on a proven EEP model for simulating experience in new product development practices The selected EEP is a joint educational program called Biomedical Innovation and Commercialization (hereinafter BIC) between National Taiwan University College of Engineering and College of Medicine. This case study is significant because of its theoretical and pragmatic values in illustrating an ideal EEP incorporating recommended factors relevant to combined processes of new product development and marketing described in the conceptual discussion. An ethnographic-based case study is conducted to determine the processes probable of engendering student actions into debatable consequences in the matter of ownership disputes.

This paper aims to contribute to both engineering design education and innovation literatures. First, it expects to provide with factual findings about how students behave through critical stages of a generic product development process in the EEP, where the EEP simulates the entire timeline of new product development cycle, and university's owned hardware/software resources and staff, and even professionals outside of university boundaries are provided for simulating a boundary-free product development environment . Second, it expects to examine potential policy inadequacy for managing student-generated intellectual property, as suggested, by way of example, [6], in order to explore rooms for improvement to fix multilevel policy misalignment. This paper's findings show that non-formal appropriability mechanism makes better sense to managing student-generated intellectual property, which is light on administration cost. It is suggested that increased delegation scope at the technology transfer office can be instrumental not just to accelerate commercialization process but also to enhance rate of survival of a new student-generated product, and increased perception of fairness in the university's innovation ecosystem because if they act as appropriate gatekeeper on checking ownership issues, there will be less uncertainty or cost in the future.

A. Governing Student-Generated Intellectual Property Resulting from Experiential Education Program

An overview of the student-generated intellectual property governance policy literature is provided below to discuss the changing role of EEP in the university setting. It then discusses the increasingly popular trend to incorporate innovation management literatures' teachings into designing elements of an ideal EEP, all together to reflect the requirement mandated on the refined role of EEP. Next, selection of appropriability mechanisms in an EEP setting is discussed.

Changing role of EEP in the era of innovation-promoting environment

Availability of EEPs are on the rise in recent years as part of a response to technology policy advance to improve the quality of the national innovation system. The role of EEP can be generally grouped into three categories, with each representing interests responsive to different institutions: (a) the role to answer industry need for workplace-ready talents; (b) the role to encourage student to engage in translating their education into new business ventures; (c) the role to help transform university expand its identity as entrepreneurial university to better face today's challenges in higher education [8].

Therefore, the instruction design and administration policy for an entrepreneurial education program need careful attention so as to minimize potential opportunistic behaviors while not reaching beyond the university's role as an educator.

Design requirement for EEP construction and administration

Today's EEPs are not identical to the EEPs in the recent past, they may be more sophisticated now than before because of what their refined roles mean for their stakeholders. This is significant as it relates to intellectual property management because it means the design requirement for implementing EEP may now be different. If the EEP is taught in a way that is different from in the past, the way the inventing students invent can be different than from the past. Therefore, in order to examine intellectual property management for EEP, the design requirement for building and running an EEP should be considered.

So how can an EEP be designed? There may be a variety of areas that course designers can choose to focus on in order to create their desired managerial effect, for example if they choose to emphasize on teaching creative thinking, they focus on only using a single type of instructor to tell students about observation techniques and inventing techniques. In this setting, there may be no need for inviting marketing experts for class instruction. Therefore it can be understood that there is no one way of designing an EEP. To answer this research challenge, this paper focuses on the factors that generally define the limit course designers' creativity.

Generally speaking, the design of EEP can be limited by two factors: conformity with university governance policies and desired learning outcomes. Conforming to university governance policies is generally done through ensuring course structure and content are defined clearly and executed faithfully in line with university directives. For examples, course syllabus for regular courses needs to align with the educational and strategic priorities of the university; it needs to be consistent with the academic standards of the university. In the case of EEP design, additional subjects need to be considered, such as authorship/inventorship of new products, privacy control of invention disclosure for patenting purposes. Desired learning outcomes for EEP generally would include cultivating inventive capability, marketing capability,

marketplace sensemaking ability and entrepreneurial attitude; examplar ways to achieve theme would include instructor selection, instruction mode, and form of assignment completion.

As a result there is a popular trend to mix a variety of new product development practices to reflect management teachings for learning new product development processes and simulating real-world experiential learning. For examples in connection with course design, university course administrators are expanding teaching staff's expertise base as a way to increase staff's knowledge heterogeneity, diversifying student capstone project availability to complement for project portfolio management, and establishing administrative protocols for commercialization efforts to complement for systemized marketing schemes. These versions of translating innovation management literatures into practice to strengthen the richness of university innovator training courses does appear to make sense, as these courses are staying true to the teachings promised by established means found to be common and inductive to effective new product development [9].

[9] presents in Figure 1 in an adapted form, a generic new product development process is illustrated as a cyclical, repetitive series of stages: insight, problem, solution, and business model. According to Furr and Dyer's (2014) systematic review, each stage can be achieved by a set of respective tools or techniques, and each technique can be used for more than one stage. For example, creativity and ideation tool can be used and is effective in the insight stage, while open innovation is effective for insight, problem stages.

As a response to the instructors and students' need for learning effectiveness from evidence-based teaching program, the design requirements for today's EEP are higher than the past standard. [9]'s comprehensive review of innovation management practices accounts for the stages commonly seen in real-world settings, and can serve as a response as a template for meeting the design requirement of today's EEPs. Potential aspects of an EEP that can be adapted to incorporate innovator's methods to deliver experiential learning experience to students and enhancing innovation capability to university include flexibility in team organization, diversity in product design topic, and robustness in scientific investigation.

Student entrepreneurs and their intellectual property resulting from EEP

Concerns have emerged from the increased emphasis on "real-world product innovation and entrepreneurship education" [6] with respect to policy setting insufficiency. One case illustrating this issue is with managing student-generated intangible properties. For example, heightened awareness of successful student-initiated ventures including Google and Facebook have increased businesses and venture capitalists' interests to enter university campus and probe into creative ideas among undergraduates as the likes as their ideas are believed to carry creativity and originality free from established industry norms. However, as business representative are welcome and indeed desired to co-create products with students, authorship dispute may potentially become more likely in situations where nascent ideas originating in-class are floating without protective measures and transferred misappropriately by business representatives into more matured ideas back in their boardroom, and ultimately assembled into marketable products ahead of undergraduate teams. Tension resolution between adhering to management literature's best practices on innovation and institutional conflict of interests requires careful deliberation in order to properly manage students' intellectual properties.

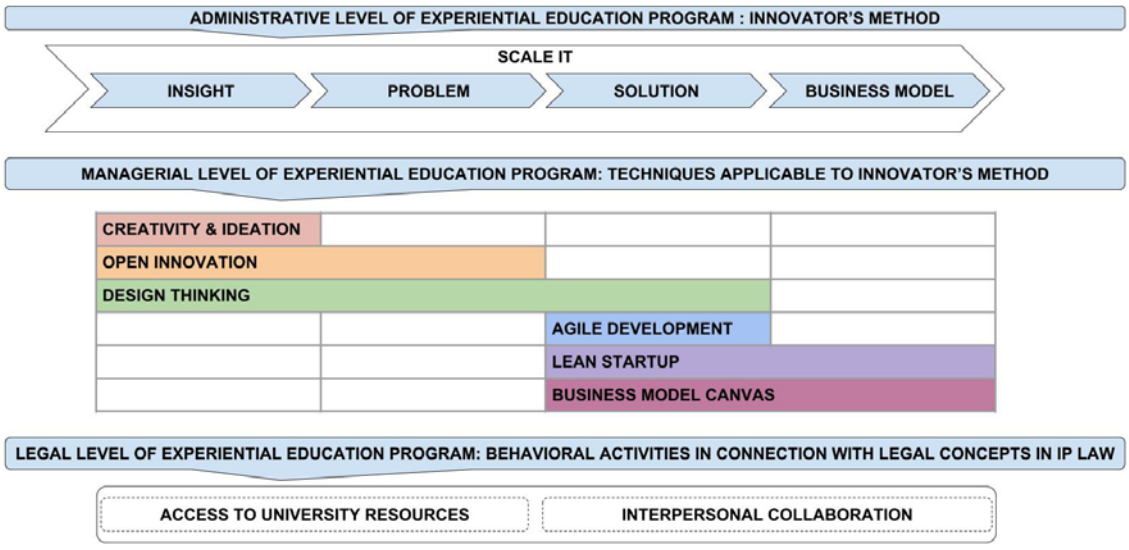

Figure 1. Research Framework for Examining Student Behaviors in Experiential Education Program.
(Adapted and reproduced from Furr and Dyer (2014))

However, skimming the literature in the past, little analysis has been done of how student-generated intellectual property should be governed under institutional conflict of interest context. [6] Institutional conflict of interest context here refers to situations where interests of stakeholders are conflicted against each other because of their home institutions' values (e.g. students representing knowledge-learning individuals, course designers and administrators representing tool-instructing individuals, venture capitalists representing private profit seekers).

Ownership as a key condition for exchange appropriability mechanisms in an EEP setting

Based on the abovementioned conceptual understanding of the current drivers behind EEP popularity, the need to consider EEP design requirement as its significance on managing intellectual property of course participants, and student entrepreneurs participating in these EEPs, we now turn to discussion on appropriability mechanism in an EEP setting.

According to [10], appropriability is the degree to which the social returns to innovation can be privately captured by the organization conducting the activity, given the conditions of the business environment in which it operates. It is a protection mechanism for protecting inventors' intellectual properties from non-inventors misappropriating the profits from their intellectual properties. Ownership is a critical condition of the appropriability mechanism for inventors to ensure for themselves an approach to profit from their intellectual properties, even in the case for student-generated intellectual property [11].

In an EEP setting, the ways to protect IP may be straightforward. University technology policy should be the first place for reference for issues including inventorship, technology transfer. However, a brief glimpse into official documents reveals that not all universities have relevant policy provisions covering for non-staff students, they all only have intellectual property policy for staff-students (i.e. graduate students employed as research assistants).

Those that do have provisions covering for non-staff students govern their intellectual properties in different governance modes. By way of example, Monash University adopts an Intellectual Property and Confidentiality Declaration as a means for assisting students and supervisors to understand the circumstances when the student must assign the intellectual property generated as part of their research program to the University [12]. Stanford University offers a management guideline specifically directed at student entrepreneurial courses, a feature is the focus on requiring the students to understand scenarios where they must assign their rights. This document is freely available also online through Office of Technology Transfer [13]. As both cases show emphasis on assignment of ownership, it is evident that ownership governance is important in managing student-generated intellectual property derived from entrepreneurial university courses.

This article incorporates into the established perspectives from management literature on innovators methods that are now common in EEP to provide a more holistic framework to examine two critical legal concepts often examined in legal issues concerning intellectual property ownership disputes in university settings: access to university resources, and interpersonal collaboration. This is demonstrated in Figure. 1: it has now been argued that the currently dominant course design philosophy of EEP is informed by perspectives based from innovation management literatures. The innovator's method, an administrative philosophy of how a new product is developed, is the administrative level. This runs in parallel to the techniques used in correspondence to each stage in the administrative level. The legal level is made of the key concepts that judicial opinions often cite as cause of judicial litigation, and it is incorporated here with the relevant techniques and methods to provide a new dimension for identifying managerial challenges with respect to legal concerns.

II. RESEARCH METHOD

A. Case selection

This study explores the behaviors of non-staff students cooperating with each other in an open-ended educational setting to exploit university resources, in order to explain the "why" and "how" of the behaviors probable of leading to IP ownership disputes.

In order to answer the stated question, the research reported in this study used a longitudinal multi-stage, nested case study design [14]. This study first conducts an archival study on university-wide circulation documents, online student community bulletins, university course offerings descriptions covering the BIC program at National Taiwan University. A case study design is selected because it is appropriate for research in developing research areas where the emphasis is on understanding the key issues in a contemporary set of events [15], and because open educational setting is new and growing phenomenon where a case study approach is suitable as a research method [14][15].

In order to investigate the qualitative processes underneath, or difficult to be represented in, registry data or survey data, this study used an ethnographic approach to detect patterns and processes that could help to "make sense of what is going on in the scenes documented by the data" [16]. The dataset resulting from this research consisted of text files composed of paragraphs describing events or statements by students. The data was studied for examplar obstacles faced by students when working with peers or faculty members with respect to collaboration, and requesting access to university hardwares/softwares with respect to resource-seeking.

The EEP program under the case study was designed based on the concepts advocated in the Stanford BioDesign program. The outcome of this course is a number of new product development teams, where each concludes the course with a solution to a medical unmet need the team members discovered during their field study at selected medical

specialty settings at National Taiwan University Hospital in Taipei City. Notable example inventions included anesthetic syringe featuring lower production cost and higher medical usability, music-based sleep inducer, color identification system for the visually impaired persons, etc. The course receives financial support from the Ministry of Education in Taiwan and conducted as a credit-granting course indexed within the university course catalogue since the autumn semester in the year of 2013. The BIC is selected as the research setting because of the following reasons: (a) it represents an EEP resulting as a response to the demands required for an EEP in the era of innovation-promoting environment. (B) Its course structure is inspired by Stanford University's BioDesign fellowship program, an EEP hosted at Stanford University famous for its application of design thinking and a few other new product development techniques in the creation of healthcare products [17]. This means for BIC that students can find themselves immersed in the entire process of new product development from start to finish. (C) The translation of the BioDesign methodology incorporates all the tools suggested by [9] for each stage of the entire process of new product development. This means for the students total immersive experience as working in a "real-world" setting: each student team is composed of diverse technical backgrounds (e.g. engineering, finance, law, management); each team is instructed to conduct field study on patient's medical needs; relevant stakeholders including venture capitalists, bank financiers, medical doctors are accepted into each student team as consultants to ideate, discuss solutions together. An average of 5-6 students would be maintained in each team, technical and experience diversity is maintained in most cases to represent knowledge heterogeneity. (D) This program is supported jointly by the Institute of Biomedical Engineering and the College of Medicine in terms of instructor staff, access to clinical testing devices, and hospital field trips. This feature implies that the students also have actual context and resources to leverage to build product prototypes and construct initial business models.

B. Sources of data

The case study primarily relies on secondary data because the BIC program has been widely publicized in media outlets at the university campus, biotechnology trade magazines, and word-of-mouth channels at National Taiwan University Hospital, it is possible to gain relevant information from these publically accessible sources. Ethnographic study relies on the author's one year active involvement in a student team as a student inventor as well as a legal representative due to author's previous work experience and training at law school. The data is based on active record of team member behaviors and behaviors of other teams because internal operation details are not easily recordable or revealed through open interviews or surveys. Candid response to surveys may be difficult to come by as students are mostly not knowledgeable about what is critical information in terms of what they might have done during each stage of the new product development process.

Behaviors under observational focus are those relevant to access to university resources and collaboration with others to reflect critical considerations in intellectual property management approaches. These critical considerations are on the usual legal checklists emphasized in courts of law, as can be summarized from court rulings.

III. RESULTS AND DISCUSSION

This study builds on the previous work in [7], which organizes results from the case study and ethnographic data to present observed behavior of non-staff students through critical stages of new product development process. Data collected from the various sources noted above are used in combination of the innovation process summarized by [9] to illustrate relevant actions. A summary of these actions are provided in TABLE 1.

TABLE 1. STUDENT BEHAVIORS IN CRITICAL STAGES OF NEW PRODUCT DEVELOPMENT IN BIC

Observed Student Behaviors Relevant to Access to University Resources and Collaboration with Others	
Creativity & ideation	● Different students come from diverse background of expertise, and work experience. It is inevitable that some students contribute more than others when contributing in terms of guiding discussion direction to meaningful conclusion, breaking collaboration crisis, and handling planning hazard (e.g. should the design topic be changed to a new one if medical doctor disagrees with their idea or should they maintain their stance and study physiology literatures to discern the challenges medical doctors face with existing medical technology?). ● By benefit of course offerings, students are entitled to have access to consult with domain knowledge experts (e.g. medical doctors), as a result students become frequent visitors to medical experts. Deliberation on how much consultation and to what degree of consultation quality to give to students is a concern that medical experts would have because medical experts may risk becoming overly exploited for advice solicitation without listing as a product inventor while they are rightfully entitled to.
Open innovation	● Some students are from venture capital firms. They are more eager to learn about undergraduate students' ideas. While there is no obvious sign of business espionage activity, it is always possible for idea fishing to happen. ● Students are required to showcase their invention to the public at the end of the course. Audience solicits reveal about the critical working part of the invention.
Design thinking	● None in particular.
Agile software Lean startup	● Students have access and do access hospital equipments or measurement devices for more than once. Normally, these equipments and devices are not accessible to the public.
Business model canvas	● Students contribute unevenly to the buildup of business model. It is observed that some reserve their assertion to claim their right of ownership of the business model creation after the business model is found to be acceptable and working, even though they did not contribute the component of the invention that makes the business model to work.

IV.CONCLUSION

The research question that this study attempts to answer to is why and how non-employment status engenders student's collaborative behaviors and university-resource -accessing behavior to cause IP ownership disputes arising from an open-ended EEP. The need to be aware of institutional design of the university, the nature and the misalignment between the public purpose of higher education and profit-seeking behavior of entrepreneurship become evident and essential for making sense of the relevance of student behavior in the discussion of probable ownership disputes. These elements are deducible from the existing legal and university policy documents and are used to make sense of the collected data to answer the research question.

As such, this study finds that the origin (why) and the emergence (how) of the behaviors probable of causing intellectual property ownership disputes come from situational processes built up by the political tension between the university and the student. This paper finds that in general, both the university and the student respectively have their own agendas to uphold, and while upholding these agendas, intellectual property ownership disputes emerge into existence, and ultimately into debates among actors during the invention commercialization phase. The challenge from the perspective of the university in managing student-generated intellectual property is with handling the balance between societal identity as an educator for public good and the role for university in the national innovation system to behave as a paid-for-order consultancy institution. The challenge from the perspective of the student in managing the same is with balancing between societal identity as a student to comply with and fulfillment of their personal socio-economic agenda.

With respect to contributions to the field of knowledge, this study's contribution is as follows. First, identification of student behaviors in EEP probable of leading to IP ownership disputes should help inform engineering design education practitioners on IP policy design with respect to what-should-be-done and what-should-not-be-done on student's part. For example, in the interest of protecting external domain knowledge experts' potential inventorship, future course administrator may now realize to be watchful of confirming early with external domain knowledge experts what and how much knowledge and time to spend with students. Innovation literature on new product development process is expected to benefit from this article in a theoretical way as this article provides individual level evidence on conflict between developer and organizational rule.

This study reports empirical findings describing student entrepreneurs' behavioral actions in various stages of an EEP in an open setting. As can be seen from the research results, although there may not be a long list of observed activities in each stage of new product development, each can be recognized to be similar to those associated with staff-students, faculty. However, because there is no clear guidelines like those of [10][11], it suggests that there may be a lack of mechanisms on the university level to management non-staff students' issues. Therefore, it is recommended for the university technology transfer office to assume the role to help non-staff students check due diligence.

This study is not without limitations. First, although the focus of this research is geared towards student behaviors probable of causing intellectual property ownership disputes, the analytical perspective assumed upon observed student behaviors was exclusively on disputes between university and student, this research setting may not be completely representative of the real world reality because there could be ownership disputes between student peers. A major portion of the student body in the BIC program was working professionals including accountants, lawyers, medical doctors, these people were students in the course and contributed to the conception of the invention produced in each inventive team. The dispute in this nature would not be about institutional pressure on inventors as in the university-versus-student case, but would be more about knowledge contribution from multiple technical disciplines. This may a good research question for legal analysis especially for legal study. Second, students' university-resource-seeking behaviors were not clearly defined. Course instructors may have different interpretations than students of what university resource may count as critical in "conceiving" the resulting inventive products, or how much time or questioning may count as critical "conceiving" the resulting inventing products. This could impact university and student's respective perceptions on who can claim ownership to the invention, as university can argue ownership because student's use as substantial to the functioning of the invention operation. Last but not least, this study is heavily limited by the confine of one case study, therefore research result cannot be generalized to cover for other actual settings. As a result, additional study on multiple cases is strongly suggested for future research.

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