Using the Industry as a Model for Better Learning Experience in Higher Education

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Abstract
The aim of this study is to evaluate how industrial approaches to learning can be introduced into logistics/supply chain management (SCM) education programs in a university setting. This issue has been examined through two case studies. The first case study outlines the current state of a bachelor education program in logistics/SCM at the University of Borås in Sweden. The second case study illustrates two education programs for practitioners in an international electronics company from Sweden. The investigated university education program has several practical goals, but few practical learning situations. The industrial case study illustrates how practical learning situations can be incorporated into the education program and this may help to improve skills and confidence of the students. Practical learning situations seem positive, but need consideration to when they are to be included in the education program.

Keywords: Education, Teaching, Learning, Project-based learning, Logistics, Supply chain, Lean, Six Sigma

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1. Introduction

Logistics and supply chain management (SCM) have both numerous different definitions (e.g. Mentzer et al., 2001), and is yet to define a clear theory area (Storey et al., 2006; Halldórsson et al., 2007). It is therefore not an easy task for students to get acquainted with this area. The logistics education given at the University of Borås, Sweden, offers a plethora of different courses in logistics, but these are centered on classroom teaching. As such, the heterogeneous and ambiguous nature of the field might not be embodied in how the field is taught.

The prevailing school of thought in pedagogics today considers a "deep" approach preferable to a "surface" approach. Teaching methods like problem-based learning will increase the students' activity levels, enabling the use of higher cognitive levels (Biggs, 1999). Key parts in a learning process are when individuals are allowed to critically reflect, to evaluate, and to seek alternative solutions. It is by critical reflection that new knowledge can be created (Olstedt, 2004a). However, when logistics/SCM is taught in classes of up to 120 students critical reflection is a challenge for the teacher and the students. It is easier to just try and convey knowledge, instead of engaging in fruitful discussions that both causes and deals with dissonance between different ideas (Hilletofth et al., 2014), a method that has shown to be successful in higher education (Muller, 2005). To create situations of cognitive distress that elevates learning we need a different approach.

Like students, practitioners of logistics/SCM are also given education. For example, there is education available in lean and Six Sigma. The difference compared to the university setting is that practitioners are not only emerged in a practical setting, their education requires improved practical skills. This approach to education might be beneficial for university students. In a report focused on how to develop engineering education, one key suggestion is that the cooperation with the trade and industry should be integrated. In this context, theory and practice should be mixed in a project-based setup, as to increase the practical content to create knowledge (Nilsson, 1999; Hilletofth et al., 2010), which is similar to that what already exists in some cases in the industry (Andersson et al., 2013).

The aim of this study is to explore industrial approaches to learning that might be suitable for logistics/SCM education programs in a university setting. This issue has been examined by outlining the current state of a bachelor education program in logistics/SCM at the University of Borås, Sweden (university case study), illustrating two education programs for practitioners in an international electronics company from Sweden (industrial case study), and by exploring how the industrial approach to learning could be adopted in the university setting, how this approach might be implemented, and what benefits can be expected.

The remainder of this paper is structured as follows: To begin with, a literature review on issues related to practice-oriented education is presented in Section 2. After that, the research method is described in more detail in Section 3. Thereafter, the university case study is presented in Section 4 while the industrial case study is presented in Section 5. After that, the case studies are analyzed in Section 6, followed by suggestions on how the industrial approach to learning could be adopted in the university setting is discussed in Section 7. Finally, the research is concluded in Section 8.

2. Literature review

In this review we focus primarily on learning in a Swedish context. Accordingly, there will be a focus on learning development in Sweden. The implications of this approach are addressed in the methodology section.

The process of learning has existed long before mankind as a mean to create knowledge. Knowledge has been passed from generation to generation expanding constantly helping the human race to evolve. The method has been practice, guided by older generations or others in the group of the learner. The process of learning was not formalized at this point but the knowledge transferred was needed to survive. As the speed of societal development increased, this old structure also needed to evolve, thus challenging the old structures (Bron and Talerud, 2004). One such example of this change is found within the military. Here, the training of soldiers was done first by the local tribe but later in military schools and training camps. The need for better-trained troops is also one of the main drivers for interest in adult learning (Bron and Talerud, 2004). An important step in this development in Sweden, connected to engineering, was taken in the 1820s with the creation of the first engineering schools. These were created mainly from the initiative of the private sector to cater to a need of special competences, or roles (Hult, 1998).

The first engineering schools in Sweden were established in three different fields: military, outdoors, and handcraft (Fransson, 2003). A not so far fetched conclusion is that they were born from a need in society to perform and solve practical problems and issues. During the evolution of the society, as the needs changed, the education programs changed and were broadened to cover more areas. The progress today, starting in the 1920s, has been to increasingly introduce theory, while reducing the focus in practical knowledge. In 2003, the Swedish University Board gave the universities criticism because practice in the industry was included in programs, but did not award any credits. It was however concluded that the practice is an important part in the education (Högskoleverket, 2003). The criticism resulted not in a solution on how to incorporate practice in the education programs, instead practice, as a mandatory part of the education, was removed (Åkerman, 2003).

From a learning perspective this goes against theories of learning, where the student is considered the main agent of learning, and needs direct experience with the phenomena of interest for the best effect (Muller, 2005). Within the engineering field this is under discussed (Fransson, 2003), and hence so is also the mix of theory and practice. Today, the mix of theory and practice is in some reports described as lacking by students. As an example, a total of 40% of the respondents in one study wanted more practice in the education while only 4% wanted more theory (Haglund, 2006).

A modern definition of knowledge is that it can be defined in four different forms: fact, skills, understanding, and confidence (SOU, 1992). Fact is knowledge as information, skills is to be able to perform a task, understanding is to comprehend a meaning of something, and confidence is the preparedness to be able to make judgment, for example, to have the gut feeling knowing when to stop or start. In this context it is easy to understand that practical knowledge is needed not as part of theory but as knowledge of its own. Theoretical knowledge is needed to create knowledge in the form of fact and understanding, while practical knowledge is needed for skills and confidence (SOU, 1992).

Skills and preparedness are strongly connected to practice, suggesting that practice is needed to be able to create knowledge in all four forms. Practice has a place in the very process of creating knowledge: to do and test are important facets of learning, and according to Glaser

(Biggs and Tang, 2011, p. 63) people learn 95% of what they teach to others and 80% of what they use and do in real life. By relying solely on what people see and hear, only half of the learning is kept. This also implies that practice is important not only as an end result, but also as a mode to create knowledge.

Critical review and critical thinking are important in order to conduct education at a higher level (Bron and Wilhelmson, 2005; Olstedt, 2004b, p. 131). Knowledge needs to be challenged, reviewed, and understood by the learner. The learning environment needs to be designed in a way that creates such possibilities. There are several opportunities to create such an environment, but a common consideration is that the learner's activity level needs to be high. Both problem based learning and case based teaching provides such settings. Problem based learning focus on giving the student responsibility in, and for, the learning process (Olstedt, 2004b). The teacher becomes the coach that facilities the learning experiences, but does not provide answers and lets the learner find ways of them own. The purpose of coaching is to spark an interest in creating knowledge, and also development at an individual level (Bluckert, 2005). It is, accordingly, seen as a tool to support individual development to think, be and learn (Berg, 2007). It has been suggested that problem solving and project-organized education can improve the learning process (Nilsson, 1999). The focus of problem-based learning is to establish the tutor/teacher as a facilitator of the learning, and attributes the learner with responsibility for the learning experiences themselves (Savery, 2006).

Researchers describe the use of practice and theory as a successful way to create knowledge. Andersson et al. (2013) investigated how Scania develops and educates its suppliers through a teaching approach including practice. Scania used a model consisting of a short theory session of 45 minutes, followed by two hours of practice, ending with individual and group reflection. Results from the suppliers included in the study suggest a positive outcome from the use of such a learning structure. This is coherent with the definition of knowledge as suggested above, where practice along with theory creates a good foundation for learning. A combination of case learning and problem solving where the learner is challenged to question former knowledge and reflect hereby create knowledge.

A possible structure to achieve practice in education is by using project based learning. The approach has advantages both from the student perspective and from an organizational perspective, which create a win-win situation (Hegarty and Johnston, 2008). Accordingly, it provides students the opportunity to take part in project and practice, creating a context in which there are possibilities to increase knowledge based on fact, skills, understanding, and confidence. The use of projects connected to courses of lean and Six Sigma training showed positive impact on the students' knowledge with no negative effect on the education (Kanigolla et al., 2014). Another possible structure is the use of thematic case based learning, which connects theory and practice, while facilitating and improving the learning process (Vivas and Allada, 2006). The conclusions are the same in both cases, the need to mix and link theory with practice is imperative in the learning process to create knowledge.

In the scientific literature it is possible to identify other subject areas in which teachers have focused on student involvement, based on constructionist ontology. Using physics education as an example we find "peer instruction" (Mazur, 1997), "interactive lecture demonstrations" (Sokoloff and Thornton, 1997), and "workshop tutorials" (Sharma et al., 2005). These processes are recursive and relational, which enables students to co-construct meaning in the group. Muller (2005) do, however, argue that participatory learning needs to come at the correct place in the education program so that the students do not risk cognitive overload due to restrictions on working memory. In a supply chain context it is important to carefully evaluate when to include practice, and to do so at a level that is suitable to avoid cognitive overload.

3. Research method

The aim of this study was to explore industrial approaches to learning that might be suitable for introduction into logistics/SCM education programs in a university setting. This study is primarily focused on a Swedish context. Different cultures with regard to education in both academia and practice necessitate that findings from this study are not transferred to different contexts. A transfer of context should be seen as a second step, in need of its own research.

The first step in achieving the aim was to examine the current state of logistics/SCM education in the university setting. It was decided to conduct a case study covering the bachelor education program "Industrial Engineering – Logistics" at the University of Borås, Sweden (university case study). This program has the highest focus on logistics of all the programs given at the university. The objective was to outline to what extent courses today specify practical elements in their goals and contents. The second step in achieving the aim was to examine education programs for practitioners used in the industry. It was decided to conduct a case study covering two education programs for practitioners at an international electronics company in Sweden (industrial case study). The objective was to investigate the structures of the educational programs as well as the approach of training students (approach to learning). The final step in achieving the aim was to examine how the industrial approach to learning could be introduced into the university setting.

The case studies are essentially a "snapshot" of how the programs are currently defined. The case research strategy was deemed appropriate since the case studies focus on exploring contemporary events, in which the researchers are not able to manipulate the state of affairs (Eisenhardt, 1989; Yin, 2009). The case studies are defined in order to make it possible to operationalize the research (Ragin, 1992) and are also appropriate for the purpose of this research (Eriksson, 2015). The cases were selected before the research was conducted, which helped to focus the data collection (Dubois and Gadde, 2002).

In the university case study, data was collected from syllabi for the courses in the education program that will be given to students who are accepted to start their education at the fall of 2015. A content analysis of the syllabi was conducted to capture the practical content and the practical learning goals of each course. Qualitative content analysis captures explicit, and/or implicit meaning in text, and sorts it into different categories (Hsieh and Shannon, 2005). The main category used was if the text contained practical outcomes, and a subcategory specifying if students were given practice to achieve these outcomes. When written, the syllabi go through several stages of corrections assuring that learning outcomes and contents are explicit and clearly formulated. Accordingly, it was considered easy to sort data into categories. Additional knowledge about the contents of the courses has been gathered through close to ten years of experience as a student and teacher in the program. It has also been triangulated through unstructured interviews with employees responsible for both the program, and the department to ensure its reliability (Flick, 2009; Yin, 2009).

In the industrial case study, data was collected through an unstructured interview with one manager in charge of the education programs and training. This manager is a Six Sigma black belt and has been in charge of both conducting education, and overseeing the education programs. The findings from the interview was presented to the manager, and then discussed with two employees, also Six Sigma black belts, that have both taken part in, and hosted, the education programs. Additionally, the case is also based on over 14 years of experience from the case company including logistics, management, and organizational development.

In order to support the final step of this study, suggesting how the industrial approach to learning could be introduced into the university setting, two interviews were conducted at the end of the study with the CEOs of two small-medium enterprises operating in Sweden. By interviewing two CEOs we tested if it was possible to use our contact network to gain access to empirical cases, in a similar way as we might do when teaching. As such, these are not used to generalize findings, but to test the possibility of establishing cooperation with the industry. In order to avoid researcher bias, all findings have been reviewed and analyzed by a third author, with no obligations towards either of the organizations at which the research has been conducted. This step can be compared with investigator triangulation, which is to use another researcher to investigate the same data (Flick, 2009), and in this case using the same protocol for content analysis.

4. Analysis of current teaching situation in logistics/SCM

The investigated program stretches over three years, six semesters. During this time the students take courses that corresponds to 180 ECTS credits, out of which 87.5 (49%) are related to the logistics field. It corresponds to 65 weeks * 40 hours. The courses' logistics contents are explained in detail below, as well as in which semester (S) they are given.

4.1 The logistics courses practical content

"Industrial Business Economics" (S2) is a first introductory course to economy for engineers. It contains three (1-3) practical goals. (1) The student should be able to present a simple budget for an organization, based on a set of conditions. (2) Adapt different models of cost distribution to the needs of a given organization. (3) Formulate overreaching goals based on the situation of an organization, and be able to motivate the decisions.

"Project Work in Logistics" (S2) includes project management, preparing the student to lead and manage a project. It contains a project-based assignment, but the syllabus does not define if the project needs to be rooted in reality, or if it can be simulated. The course contains four (4-7) practical goals. (4) Define project goals, divide the project into phases and define goals for the phases. (5) Create and use different models for project management. (6) Present clear and correct reports on the progress of a project. (7) Analyze materials and information flows at a company.

"Logistics – Tools and Methods" (S3) is the first course primarily focused at logistics. It contains an assignment, which is based on a fictive case, and simulates that the students help a company. The course contains two (8-9) practical goals. (8) Apply methods related to the role of logistics in organizations and supply chains. (9) Use analysis methods to solve logistics related problems.

"Production Engineering" (S3) is focused on logistics internal to a company, especially efficiency in production and material flows. Simulations are part of the course, but it is not defined if or how they are constructed. The course contains two (10-11) practical goals. (10) Be able to analyze and increase efficiency in a production process focused on manufacturing. (11) Be able to take part in manufacturing improvement at a producing company.

"Lean Management" (S4) also contains improvements in production processes, but is focused on Lean (Ohno, 1988). Simulations are included in the course, but they are not defined in the syllabus. The course contains six (12-17) practical goals. (12) Be able to utilize the basic tools used in lean. (13) Reduce non value-adding activities and reduce lead times in both public and private sector. (14) Be able to swiftly respond to new customer needs in both public and private sector. (15) Be able to use available resources in a more efficient way in both public and private sector. (16) Be able to identify areas of potential improvement in public and private sector. (17) Evaluate logistics solutions impact on the network [of actors] efficiency and the environment.

"Operations Management" (S4) does not contain any practical goals. The course contains a project work, but the syllabus does not specify if it is connected to any real-life application or not.

"Supply Chain Management & Purchase" (S5) is the second course in the program directly focused at logistics. The course contains a project, which is often done with companies, but the syllabus does not specify that this needs to be the case. The course contains two (18-19) practical goals. (18) Apply methods related to time, quality, and costs with the purpose of improving efficiency in logistics and the competitiveness of the supply chain. (20) Apply lean and just-in-time thinking in a supply chain.

"Distribution and E-Business" (S5) is a new course that has not yet been given. It contains a project work, but it is not defined if it needs to be done in the industry or not. The course contains six (20-25) practical goals. (20) Understand how distribution networks and IT-systems can be applied in a simple practical case. (21) Apply methods for network optimization, transportation cost analysis, and pricing. (22) Identify the improvement potential in a transportation or distribution network. (23) Analyze and identify the need for IT-systems. (24) Evaluate network solutions for distribution. (25) Evaluate logistics solution's effect on the network efficiency and the environment.

"Material and Production Management" (S5) is one of the more advanced courses in logistics, focusing on planning. The course has one (26) practical goal. (26) Evaluate suitable material and management conditions for an organization.

"Logistics theory and its applications" (S6) is designed to be a theoretical course explaining the theories behind what has been taught in earlier courses. It has no practical contents.

"Manufacturing Simulation" (S6) is centered on programming and simulating flows using computer software. During the course a smaller data collection is performed for a simulation. The course has one (27) practical goal. (27) Collect the data needed to create a simulation of a real system.

"BSc Degree Project in Industrial Engineering" (S6) is the bachelor thesis course. Most students chose to, and are encouraged to, do a practical project. The course has one (28) practical goal. (28) Independently work as a university engineer.

4.2 Summary of the logistics courses practical content

In total the courses contain 28 practical goals. As such the program has a high focus on preparing the students for work they will face outside of academia. These goals stand in stark contrast to the practical contents stipulated in the syllabi. In only a few cases is it specified that some practical work is needed, but it is vaguely defined and does not necessarily reflect "practice".

It is also worth mentioning that “Project Work in Logistics with Project Management” is given to the students during their second semester. This course has the potential of being a practically oriented course, but it is questionable if it is rewarding for the students at such an early stage of the program.

5. Learning in the industry

The investigated industrial educational programs include training programs in Lean and Six Sigma. These are given to employees in different departments and levels of the organization, with employees of different educational and professional background.

5.1 Lean training program

The company has developed a five-day education program with the main aim to train employees in lean, as defined by the company. The education program has two main goals. The first is to create a better understanding of lean in general. The second is to improve the skills and confidence in both using the tools that lean provides, and to be able to coach others to also use the tools.

The education program spans over five full workdays and includes homework between each day. The program utilizes a mix of theory and practice. The practical part is performed in the daily operation, or by simulated cases. Most of the blocks of program start with an introduction of theory followed by a practical workshop, or a session ending with a presentation of results and reflection. Most of the performed work is done in teams. Even though the education program is less then one year old, the response from the attendees has been promising. The participants consist of a mix of employees with and without a university degree.

5.2 Six Sigma training program

Besides lean education, the company also has an internally developed education program for Six Sigma. The program contains different levels of complexity, or levels, according to a system of “belts”. The belt system draws from martial arts, where the practitioner is awarded with different belts as his or her skill increases. The aim of the program is to train employees to be improvement leaders able to initiate and manage improvement projects. Once again the goals are twofold. The first is to provide the learner with tools and techniques used for analyzing and understanding complex relations and causes within the organization. The second is to provide them with a framework for initiating and managing improvement projects.

The highest level currently offered by the company is “black belt”, including 20 days of training in a classroom setting. It uses a mix of theory and workshop exercises to teach tools and techniques, and the theory upon which they are based. In the course it is included to define, initiate, manage, and implement an improvement project with a verified annual saving of 1 MSEK (~€100). The results from the education program prove many tangible results in form of cost savings, but it also develops the employees that have participated in the program. According to the company, the program is desirable by the employees due to its reputation for personal development. Stating this, it should be remembered that many of those who complete the program already have a university degree on both bachelor and/or master level, which puts the value of the program in relation to the conventional university education.

6. Analysis

There is a notable discrepancy between the stipulated amount of practical goals, and practical contents identified in the university case study. The amount of practical goals implies that there is a wish to prepare the students for a life outside of academia. A preparedness that would likely benefit from more practical contents in the courses (Muller, 2005). Kanigolla et al. (2014) identified positive knowledge outcomes by working in projects. It seems as if several of the practical knowledge goals stipulated could be reached if the university arranged such opportunities for the students.

"Project Work in Logistics" seems to be a promising course to use practical tools and methods to teach logistics. However, this course is placed in the second semester and caution is needed. At this stage in the education the students have not yet learned about logistics theories, or models. As such, they run the risk of facing cognitive overload (Muller, 2005), and the students likely need a lot of supervision to avoid slow and time-consuming learning (Sweller, 2004).

The course that currently holds the highest potential of including participatory-centered learning is "BSc Project in Industrial Engineering". Two problems exist with relying too much on this course. The first is that this course is not required to be practically oriented. Although most students opt for thesis projects at companies, not all do. The second is that the thesis is when the skills are put to the test. As such, the knowledge should have already been acquired.

It seems as if there are two possibilities to include "skills" and "confidence" (SOU, 1992) in the education. The first is to add practical contents into the existing courses. The second is to designate specific courses. Increasing practical contents might result in increased workload for the teachers, in which case it is necessary to allocate time to allow such activities. Designating a specific course requires space in the education program. Currently it seems as if the space is available, if the "Project Work in Logistics" is adapted accordingly. However, it would need to be moved to a later stage in the program, but still be prior to the thesis project.

Turning to the industrial case, the Six Sigma education program utilizes the project based learning, as suggested by Hegarty and Johnston (2008). According to the company this has been a successful approach beneficial to both the company and the learner, and is an example of a win-win situation. The lean education program does not have a project based learning structure, but still utilizes the important mix of theory and practice (Andersson et al., 2013). The findings suggest that such a mix was a good approach, which is coherent with the company suggestions. The general result was that the company in most cases utilizes a structure of theory and practice to perform education.

7. Suggestion Going Forward

The results from the interviews with the two CEOs of small-medium enterprises operating in Sweden suggest good prospects to incorporate real life cases into the university education. Both CEOs could list several interesting possible cases that could at least serve as cases for logistics/SCM courses. Both interviews suggested cases related to stock/warehouse dimensioning, which could be included into logistics courses, and at the same time would help the companies to improve their operations. The main obstacles discussed were to arrange a setting for meeting the students and to deal with practical issues, such as establishing contact points and to allocate the time to work with the case and the students.

There are several opportunities to improve the mix of theory and practice in the investigated university education program. This would help to better reach the goals in the course and at the same time offer a better learning experience for the students. Our suggestion is to add practical contents into the existing courses and to designate specific courses. This suggestion is made both based in the literature but also supported by the findings in the industry.

The first step could be to develop a more mix theory and practice approach in the education already suggested by the goals in the syllabi. Theory sessions, which are followed by cases and reflection is a suitable way to combine theory and practice (Andersson et al., 2013). This is possible to do in two ways: The first is to locate a session at a company location, utilizing their operation as learning context/case study. The second is to use senior students in the course to present own experienced cases (without their solutions), and to use it as a part of the learning process. This case approach would both suggest a possibility to add critical reflection of previous experiences as a learning platform, which is a desired pedagogical approach in higher education (Bron and Wilhelmson, 2005, pp. 9-10). This also present a context in which the students can test and see theory in a practical application and try some tools creating knowledge in terms of skills and confidence.

The second step that we suggest is to find a way to implement a similar structure of that of project based learning, as in the case of the Six Sigma training. A larger case together with the industry could provide a good foundation to create knowledge and to see the tools, theories and ideas in reality. Even if it is tempting to propose a thematic based case approach, like the one argued by Vivas and Allada (2006), it would most likely be difficult due to resource constraints. The changes suggested above would in of themselves need a great deal of time to be realized. The structure, however, creates a situation where it is needed to critically reflect and think about the adaption of tools and theory in a practical context. As such, it will help to convert fact knowledge into skills and preparedness.

8. Concluding remarks

This study aimed to explore how industrial approaches to learning might be suitable for introduction into logistics/SCM education programs in a university setting. The literature review has shown several benefits of combining practical and theoretical education (e.g. Muller, 2005; Vivas and Allada, 2006; Biggs and Tang, 2011). The main potential benefit for knowledge is to increase the four forms of knowledge: fact, skills, understanding, and confidence (SOU, 1992), of which skills and confidence seem especially reliant on practical contents.

In the investigated program we saw a high prevalence of practical goals, implying that the university wants to prepare the students for practical knowledge. The lack of practical contents, however, points to a mismatch between what is desired and what is done. The research implies that teachers need to add practical contents into their courses, but also that support from the management level is necessary. Management needs to allocate time so that teachers can effectively incorporate practical contents, and management also needs to analyze the entirety of the education program to place practical courses in the most suitable semester.

We would once again like to highlight that this study is conducted in a Swedish context. Accordingly, literature and data is centered on a specific country. In order to transfer the findings to a different national, or cultural context it must be considered how that context differs from the one in this study. Regardless of context this study highlights that there is a disconnect between the goals for higher education and how teaching is actually conducted, and that solutions might be found in the industry. This finding does not seem to be contextually constrained, and it is likely that education programs in other contexts suffers from the same problems, and might find solutions from their local industry.

A problem that has not been discussed here is how the Swedish government evaluates the education. It has been seen in the past that the educational board of the country is not always focused on the practical skills that the students bring with them to their professional career, but that focus instead might be on credits. The universities seem to be stuck between what is stipulated from above, and what is actually beneficial for the students and the society at large. This is a sustainability issue that needs to be resolved to ensure better education, and economic compatibility of the country.

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