UDC (07)621.7,621.8
DOI: 10.25140/2411-5363-2018-3(13)-68-73

Peter Tuleja, Pavlo Mamontov

APPLICATION OF INDUSTRIAL PNEUMATIC COMPONENTS IN THE EDUCATIONAL PROCESS

Urgency of the research. *Modern production requires schools to have a skilled workforce. In general, schools can not fulfill this requirement at the same time.*

Target setting. *The aim of the project described in the article is to build an education system that would give students the necessary experience to handle the challenging tasks of technical practice in designing and deploying automated devices.*

Actual scientific researches and issues analysis. *The results of the diploma project, to which both authors co-authored, were used as the basis for this article. Problems in the area described are known and, in principle, eliminated by a change in access to the educational process at universities. The project described in the article should be a pilot project.*

Uninvestigated parts of general matters defining. *Despite attempts to solve the problem of training a skilled workforce, without material support or cooperation with technical practice, there is no hope for success.*

The research objective. *The aim of the described project is to set up a training system in which the student would collect as much practical experience as possible for the practice.*

The statement of basic materials. *Resources to solve this problem practically do not exist, because the breadth of the problem is very big. The success of the project in the future will be heavily dependent on the enthusiasm of followers (students) in developing the job. Of course, provided sufficient financial coverage.*

Conclusions. *The pilot project is in the process of being developed. There is currently support for its continued existence, but there are no stable sources of financial inputs yet.*

Keywords: *training workplace; automation; logical controller; pneumatic components.*
Fig.: 7. References: 10.

Introduction. At present, the economy of European coutries to rapidly rise. To ensure necessary workforce for running companies is not sufficient merely quantitative aspect; started the era in which companies „call“ for qualified workforce.

In our country, in Slovakia, this trend is most pronounced in automated operations, especially in automotive.

If we want to satisfy the labor market in this respect, it is essential to prepare well graduates of secondary schools and universities.

On secondary schools, the companies itself started to implement the so named „dual education“. Univerities are slightly behind in this area.

Therefore, the idea of modifying the teaching process and incorporating more practical activities with which students would confrot in the course of study was created in the field of our department and institute.

Practical educational process. We began to implement a form of teching at training workplaces.

This model is applied to the teaching of robotics, automation techniques, but also to more elementary disciplines, fluid mechanisms, in particular compressed air driven mechanisms.

In order to prepare our students in this field, we have already been purchased the professional training workplaces of companies FESTO and SMC, where students can put into the issue of the use of compressed air at all control levels: mechanically, manually, by compressed air and elctronically.

There are 4 workplaces (from each of the mentioned companies two), Fig. 1a, 1b.

Currently, educational documentation (lectures, training tutorials) is being prepared for these workplaces and methodical teaching procedures are being gradually elabrated.

An essential feature of this project is that students are confronted with an elementary base that is the same as that use in technical practice.

© Tuleja P., Mamontov P., 2018

a *b*

Fig.1. Training workplaces:
a – FESTO; b – SMC

Source: authors foto.

Students thus learn not only how to use the given components but also gain practical skills an knowledge about their construction and application specifics.

The educational process is then divided into three stages: circuit assignment according to the wiring diagram, drawing the wiring diagram according to the wiring circuit and searching for and troubleshooting the wiring circuit according to the wiring diagram.

This model has proved to us in many ways and helped to improve the quality of processing projects solved in the tesis.

The model, however, does not allow the student to become familiar with the problem of complex assignment as is customary in practice.

The project solver from the customer will get a basic description of the problem (mostly dimensions, shape and weight of the manipulated component and starting position and ending position of the handling task).

The rest is on his skill, knowledge and experience.

The university graduate can only rely on the experience which ones gain.

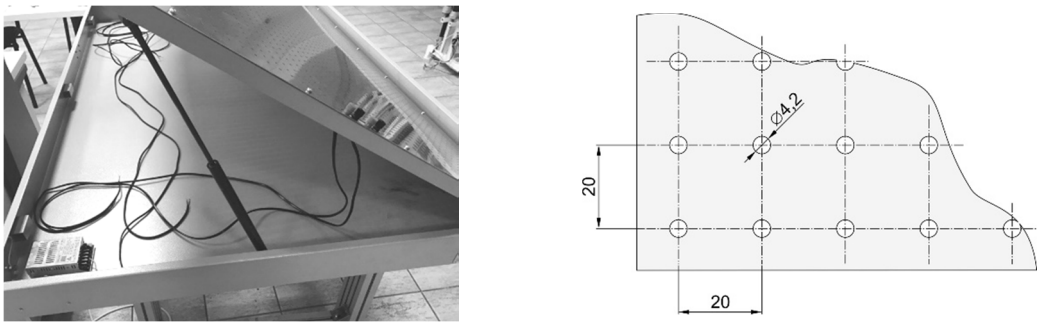
Students can gain experience while at school only if it is provided on real devices.

That is why we have begun to build a system of preparation for our students at the institute.

New model of educational process

Its essential part is the stendfor building simple workplaces from pneumatic elements. Stend emerged as an outgoing solution to the graduate thesis of our graduate.

Its construction consists of a steel frame with a deflectable lid made of perforated stainless steel sheet, Fig. 2, *a*.



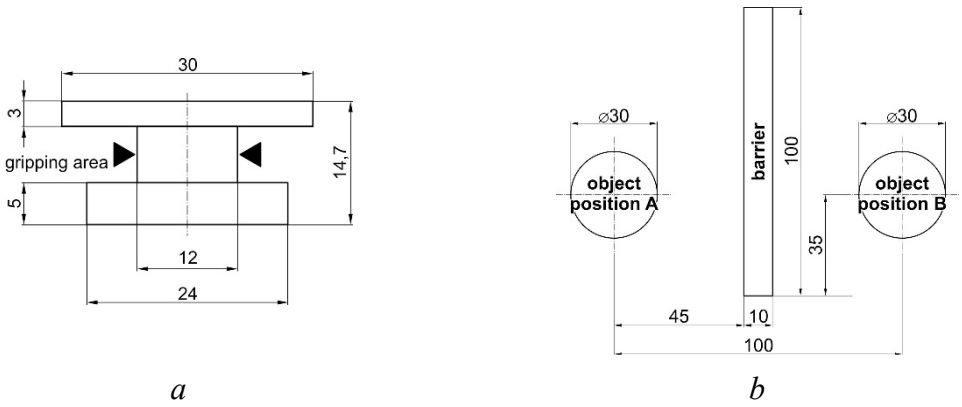
a *b*

Fig. 2. Stend for a educational system:
a –deflectable lid; b – holes distribution

Source: authors.

Circular perforation holes have a iameter of 4,2 mm. Their distribution is shown in Fig. 2, b. This makes it relatively easy to fix the components needed for the project.

At the begining of the semester, the student gets the task entry formulated as it is in the firms. E. g.: «Move component, Fig. 3, a, from the point A to point B in accordance with the layout plan, Fig. 3, b».



a *b*

Fig. 3. Task entry:
a –parameters of component; b – layout plan

Source: authors.

At the beginning of the solution, the student presents variants of the kinematic aeeangement of the future manipulation mechanism in the form of a diagram. From these varriants, the teacher selects a specific design with which the student is still working, Fig. 4.

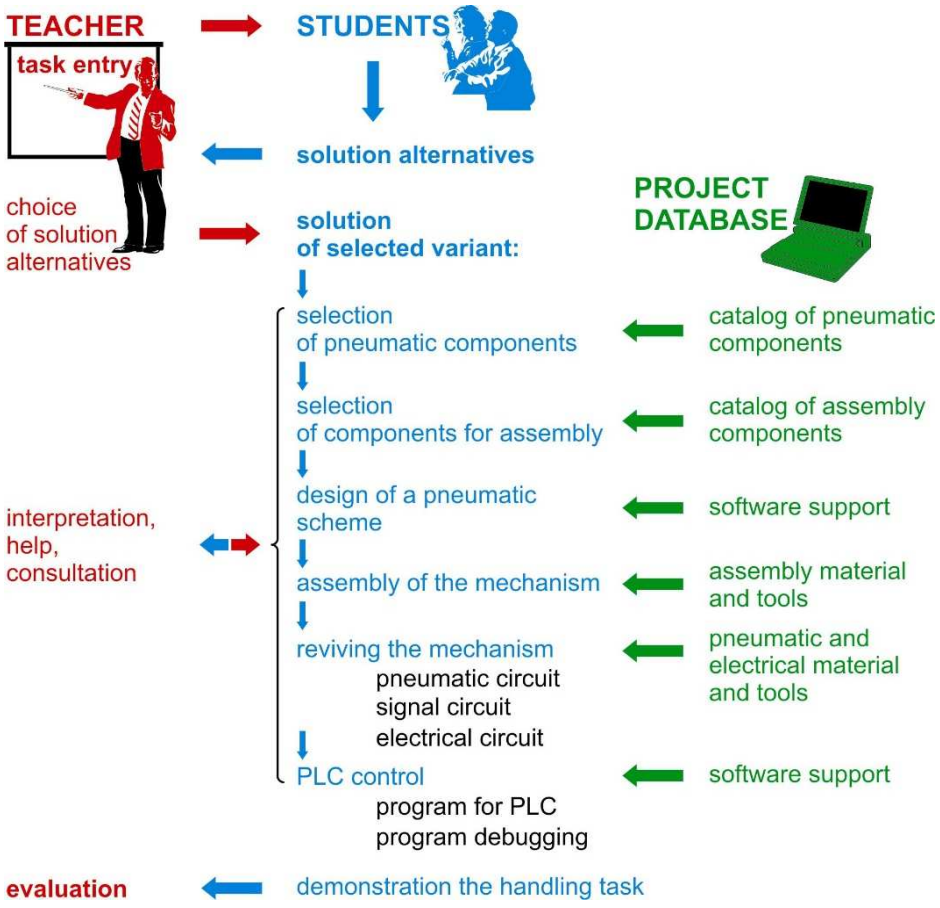


Fig. 4. Model of teaching plan

Source: authors.

As this is a pilot project of this type at the department, we plan to create an internal catalog of available pneumatic components (ctually existing and equipped with necessary components). To him (at the elaboration stage),the student will have at his disposal a set of mofules required to couple the individual pneumatic components to one another, respectivelly for clamping them onto the perforated palte of the stend mounting plate (see Fig. 4).

In this way, by combining suitable pneumatic modules and auxiliary modules, a real mechanism can be designed to enable the desired handling cycle to be achieved.

As a matter of course refers to the physical implementation of the proposed mechanism of the recovery and the creation of the control program.

Therefore, the control apparatus is also necessary to implement the mechanism. This is ensured by the small controller of SIEMENS LOGO! ..0BA6, which together with the expanding module provides the ability to control 12 outputs and receive ambient signals on 16 inputs, Fig. 5. The signals connected as inputs to the logic unit are provided by magnetic contactless sensors, mechanical switches, or inductive and optical sensors, which provide a switching element as information on reaching the end or other important position of the mechanism.

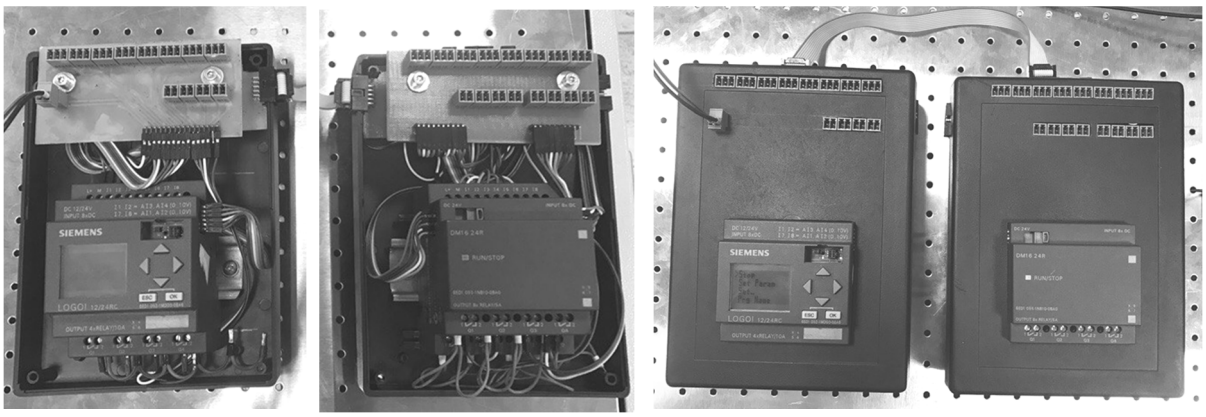


Fig. 5. Modified controller

Source: authors foto.

After its completin (recovery) will also be availeble electronic multi-position movement linear unit. It is based on a stepper motor. It allows the connection of the pneumatic components to create a multi-position TTT module which can be controlled by the otput signals from the controller, Fig. 6.

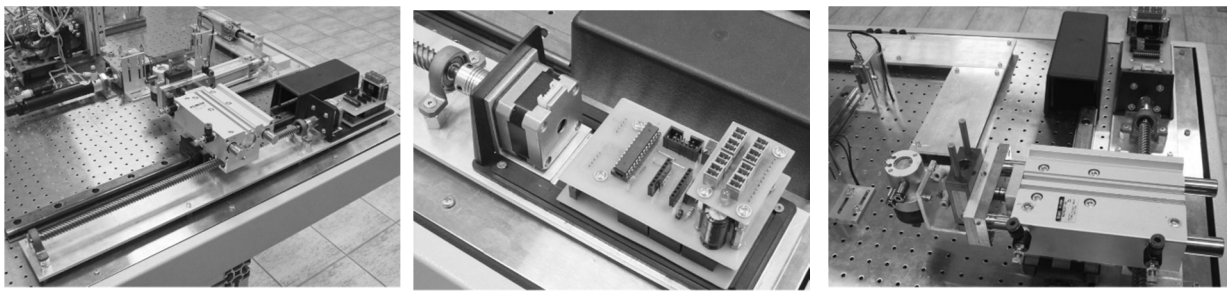


Fig. 6. Multi-position linear unit

Source: authors foto.

At present, there are approximately 40 pneumatic components from the world's, manufacturers (SMC, FESTO, HOERBIGER-ORIGA, BOSCH-Rexroth, MECMAN, AVENTICS-Emerson), linear lines (HIWIN), and the above-mentioned assembly of interconnection modules made of different Al-profiles.

As a support for the overall educational environment, ready-made assemblies are also avilable which serve exclusively to gain the necessary experience in programing logic controllers, Fig. 7.

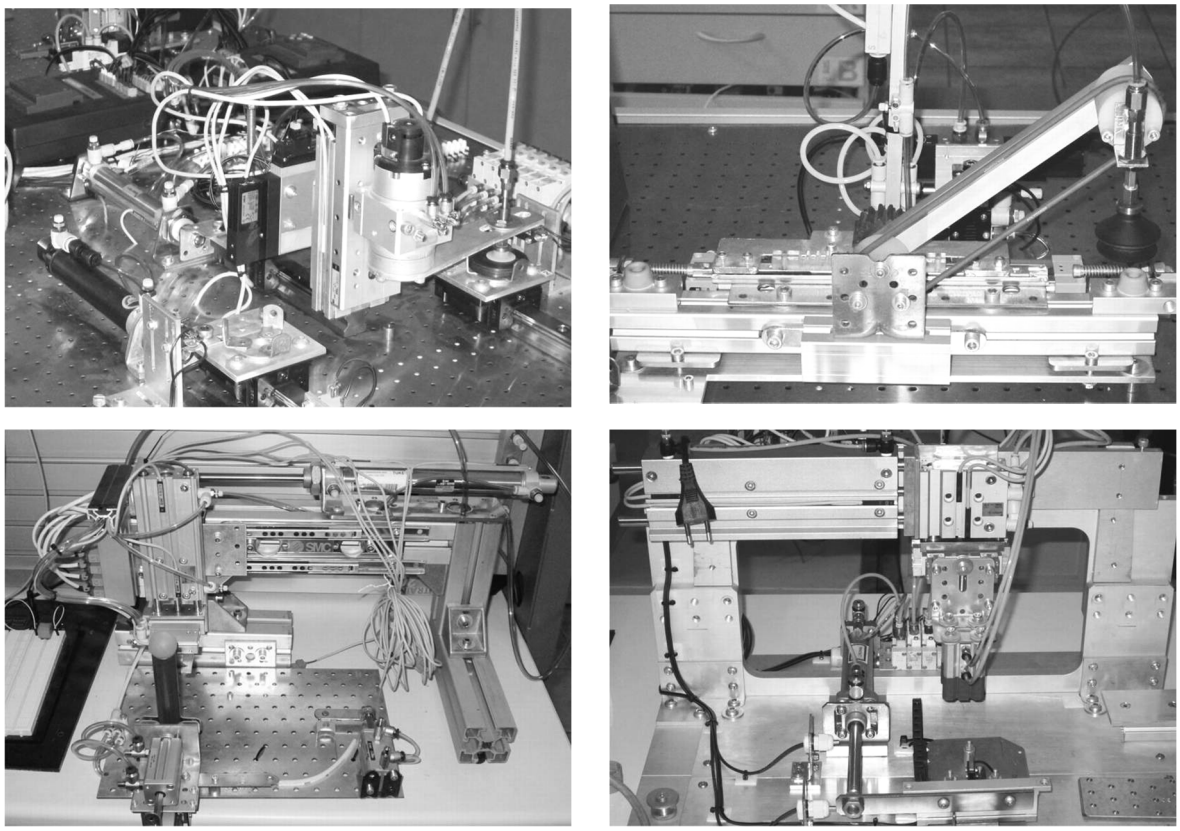


Fig. 7. Models for a PLC programming training

Source: authors foto.

We must not forget that we are educating future engineers, so the student's own soluyion must be supported by the appropriate calculations for the pneumatic circuit as well as for the selection of individual components (power and geometric analysis).

By limiting the whole project, the fact remains that at a certain moment it is possible to install and operate a limited number of mechanisms (total built-in area and I/O capacity of the controller's signal) on the stend surface.

The solution seems to be building more stends and buing more controllers.

Only such a komplex project implemented in teaching units as well as outside the teaching process gives at least a minimal basis of experience for the realisation of future larger projects of our graduates in practice.

The co-autor osf this article and the autor of the diploma project described above is now successfully employed in a Slovak firm focused on industrial and power engineering.

Conclusion. The project itself has yest to be implemented from the material resources of the department, and its expansion in the future will probably require funding from a grant or other agency supporting the development of sililar activities.

We believe that we will be given the necessary support and the project will be transformed into a relaization outputin the form of an aducational means to support one of the semester subject conducted in teaching process at the our department.

This contribution is the result of the project implementation: Research modules for intelligent robotic systems (ITMS: 26220220141) supported by the Research & Development operational Program funded by the ERDF.

References

1. Góts, I., Smrček, J., Rimár, M., Perečinská, V., Henriczyová, T., Tuleja, P. & Šidlovská, Ľ.(2000). *Bewertung der Qualität der universitären Lehre in technischen Fächen*. TU in Košice [in Slovak].

2. Hajduk, M. & Tuleja, P. (2013). *Základy pneumatických mechanizmov.* Výroba, úprava a rozvod stlačeného vzduchu a vákua, Edícia vedeckej a odbornej literatúry, TU v Košiciach, Strojnícka fakulta [in Slovak].

3. Stejskal, T. & Tuleja, P. (2003). Úrovne automatického riadenia mechanizmov. *Acta Mechanica Slovaca, 7*, 141-144 [in Slovak].

4. Tuleja, P. (2015). Energy saving when using compressed air as an instrument of environmental protection and economic balance of the company. *Global Management and Economics, 1,* 1, 128-133 [in English].

5. Tuleja, P.(2008). Netradičný spôsob riadenia jednoduchého pneumatického manipulátora. *Acta Mechanica Slovaca, 12* [in Slovak].

6. Tuleja, Peter - Petruška, P. (200). *Počítačom podporovaná výučba pneumatických prvkov v laboratórnych podmienkach [Computer supporting education of pneumatic components in laboratory clause].* Počítače v teórii a praxi. Košice : TU-SjF [in Slovak].

7. Tuleja, P., Semjon, J. (2015). Energy audit of automated operation. *Transfer inovácií, 31,*147-150. ISSN 1337-7094 Acces of: http://www.sjf.tuke.sk/transferinovacii/ pages/archiv/transfer/31-2015/pdf/147-150.pdf [in English].

8. Tuleja, P. & Varchola, M. (2011). Metodický model prípravy študentov k zvládnutiu problematiky praktického nasadzovania automatických zariadení pracujúcich na báze stlačeného vzduchu. *International Scientific Herald,21(2*), 106-113. ISSN 2218-5348 [in Slovak].

9. Tuleja, P. & Varchola, M. (2008). *Model výučby programovania logického kontroléra pre malé aplikácie*. Lisbon Strategy as a Determinant Factor of European Integration in the Sphere of Education and Science: international scientific herald: collection of Scientific Articles Based on the Materials of the 16th International Scientific-Practical Conference Held, 6-9. Užhorod : ZDU, 2008 P. 17-21. - ISBN 978-966-2195-32-3 [in Slovak].

10. Varchola, M. & Tuleja, P. (2010). *Metodičeskaja mode podgotovki studentov dlia primeneniia na praktike avtomatizirovannych ustrojstv rabotajuščich na osnove sžatogo vozducha*. Zbirnik naukovich prac Kamyanec-Podiskoho nacionanoho universitetu imeni Ivana Ogienka: serija pedagogična. Kamyanec-Podiskyy: K-PNU imeni Ivana Ogienka, 2010 P. 188-191 [in Russian].

УДК (07)621.7,621.8

Петер Тулейа, Павло Мамонтов

ЗАСТОСУВАННЯ ПРОМИСЛОВИХ ПНЕВМАТИЧНИХ КОМПОНЕНТІВ В ОСВІТНЬОМУ ПРОЦЕСІ

Актуальність теми дослідження. *Сучасне виробництво вимагає від освітніх закладів оволодіння випускниками професійними навичками. Разом з тим школи не можуть виконати цю вимогу.*

Постановка проблеми. *Метою проекту, описаного в статті, є створення навчальної системи, яка дасть студентам необхідний досвід для вирішення складних завдань під час практичної діяльності при проектуванні й застосуванні автоматизазованого устаткування.*

Аналіз останніх досліджень і публікацій. *Основою для цієї статті були результати дипломного проекту, в якому обидва автори були співавторами. Проблеми в описаній сфері відомі й загалом усунені шляхом зміни підходу до навчального процесу в університетах. Описаний у статті проект є пілотним.*

Виділення недосліджених частин загальної проблеми. *Вирішення проблеми підготовки кваліфікованої робочої сили потребує матеріальної підтримки або співпраці з виробництвом.*

Постановка завдання. *Метою описаного проекту є створення навчальної системи, в якій учень буде отримувати якомога більше практичного досвіду для навчання.*

Виклад основного матеріалу. *Ресурсів для вирішення цієї проблеми практично не існує, тому що проблема дуже істотна. Успіх проекту в майбутньому буде сильно залежати від ентузіазму послідовників (студентів) у розробці проекту. Безперечно, за умови достатнього фінансування.*

Висновки відповідно до статті. *Пілотний проект перебуває в процесі розробки. Нині підтримується його подальше існування, але поки немає стабільних джерел фінансування.*

Ключові слова: *навчальне робоче місце; автоматизація; логічний контролер; пневматичні компоненти.*

Рис.: 7. Бібл.: 10.

Tuleja Peter – Eng., PhD, assistant professor, Technical university in Kosice, Faculty of Mechanical Engineering, Institute of Automatization, Mechatronics and Robotics, Department of Robotics, Komenskeho Park 8, 042 00 Kosice, Slovakia.
E-mail: peter.tuleja@tuke.sk
Scopus Author ID: 55570858300

Mamontov Pavlo – Eng., technical, PHU Elektra, s. r. o (Ltd.), Zborov nad Bystricou 644, 023 03 Zborov nad Bystricou, Slovakia.
E-mail: pavelmamontov@yahoo.com

Tuleja, P., Mamontov, P. (2018). Application of industrial pneumatic components in the educational process. *Technical sciences and technologies*, *3* (13), 68–73.