12th INTERNATIONAL

WORKSHOP ON KNOWLEDGE MANAGEMENT

12th International
Workshop on Knowledge Management

Medzinárodný workshop znalostného manažmentu

Proceedings

Vysoká škola manažmentu v Trenčíne, October 12 - 13, 2017

Trenčín, SLOVAKIA, 2017

12th International Workshop on Knowledge Management

12 – 13 October 2017 in Trenčín

Conference Proceedings / Zborník príspevkov

School of Management in Trenčín / Vysoká škola manažmentu v Trenčíne

Bezručova 64, Trenčín, October 12 - 13, 2017, Slovakia

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9 788089 306350

ISBN 978 – 80 – 89306 – 35 - 0

Content

Seminar S2 - Universities, SME's and Knowledge Management

Moderated by S. Ferenčíková

Photos

ALBUM 12th IWKM – I.

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Foreword

These proceedings contain contributions to the 12th International Workshop on Knowledge Management (IWKM) held on 12 and 13 October 2017 in Trenčín, Slovakia. After a couple of years it returned to the place when its international history started. The first two sessions (in 2006 and 2007) were organized in Bratislava as a national event. In 2008, it moved Trenčín to be a part of the International Summer School on Knowledge Management sponsored by the European Union annually till 2010. Between 2011 and 2016, it was held in Bratislava again.

The 12th workshop used its sound format of two day scientific event. The first day (Thursday, Oct 12) started with two seminars. The first one - moderated by P. Berka – discussed Data Mining Tools and Computer Aided Quality. The second one - moderated by S. Ferenčíková – was a panel discussion dealing with Universities, SME's and Knowledge Management. In addition to the introductory talks, both event concentrated on the communication between presenters and audience. That's why our proceedings only contain the speakers' introductory slides.

The Thursday afternoon and Friday morning were primarily devoted to the presentation of results of researchers from Czech Republic, Finland, Germany, Slovakia and U.S.A. In total, 13 contributions were presented. The format of workshop (in our IWKM interpretation) also means that the discussion is not limited and the audience can freely discuss with every presented immediately after his/her presentation. This makes not only IWKM special, it also build a friendly atmosphere and helps in building a community around it.

You all are kindly welcome it in your 2018!

Trenčín, 1 November 2017

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Business Rules Management Systems

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Abstract: Knowledge Management, an established research and application area aim at generation, representation, storage, transfer, transformation, application, embedding and protecting of (organizational) knowledge to "bring right knowledge to right people at right time". KM efforts typically focus on organizational objectives such as improved performance, competitive advantage, innovation, the sharing of lessons learned, and continuous improvement of the organization. Recently, the notion of business rules management systems (BRMS) emerges in the business people community as a new category of decision support systems. The paper reviews the basic principles of business rules and shows how they are influenced by expert systems, developed in the artificial intelligence community more than 30 years ago.

Keywords: knowledge representation, expert systems, business rules management systems.

1 Introduction

Knowledge representation and reasoning using knowledge are central to AI (artificial intelligence) research. Many of the problems of which machines are expected to solve will require extensive knowledge about the world. This fact has been realized in mid. 70th of the 20th Century and implemented in so called expert systems (ES), or knowledge-based systems (KBS), a "computer programs that emulate the decision-making ability of a human expert" (Jackson, 1990). The role of knowledge has been recognized also in the area of business and management. Knowledge Management (KM) comprises a range of practices used in an organization to identify, create, represent, distribute and enable adoption of insights and experiences. Such insights and experiences comprise knowledge, either embodied in individuals or embedded in organizational processes or practice. Knowledge management thus aims at generation, representation, storage, transfer, transformation, application, embedding and protecting of (organizational) knowledge to "bring right knowledge to right people at right time". KM efforts typically focus on organizational objectives such as improved performance, competitive advantage, innovation, the sharing of lessons learned, and continuous improvement of the organization. Recently, the notion of business rules management systems (BRMS) emerges in the business people community as a new category of decision support systems. The paper reviews the basic principles of BRMS and shows how they are influenced by expert systems, developed in the artificial intelligence community more than 30 years ago.

2 Business Rules

A business rule is a rule that defines or constrains some aspect of business and always resolves to either true or false. Business rules are intended to assert business structure or to control or influence the behavior of the business. According to [9], business rule is "a compact statement about an aspect of business". To quote further: "The rule can be expressed in terms that can be directly related to the business, using simple, unambiguous language that is accessible to all interested parties: a business owner, a business analyst, a technical architect, and so on". There is no single categorization of business rules. Different authors even consider not only IF-THEN structures but also other "pieces of knowledge" to be business rules. So Ross counts among business rules also definitions of business terms and facts [3], von Halle [12] counts among business rules also constraints ("MUST HAVE" statements), guidelines ("SHOULD HAVE" statements) or computations ("IS COMPUTED AS" statements). An example of a business rule in a IF-THAN form can be [11]:

Check the product number in database SRU.
If the product number is equal to 422 [the part number of flip-flops]
and the product description is equal to plastic flip-flops,
then set the new product number in database ASC equal to 1547
and set the product description equal to Fun-in-the-Sun Flip-Flops
else if the product number in database is equal to 423 through 495
then set the new product number equal to 1647
and set the product category equal to Good for You, Too Sandals

The next example of a IF-THEN business rule bellow shows, that even if uncertainty processing is not an issue for business rules, the rules can contain vague concepts ("rush" order, "hazardous materials", "remote" destination) [6].

An order must be shipped by premium service if
the order is a rush order and
the order includes hazardous materials and
the customer is a platinum customer and
the order destination is remote.

The basic principles of business rules have been expressed in the so called Business Rules Manifesto presented in [10]:

1. Primary requirements, not secondary: rules are essential for business and IT models.

2. Separate from processes, not contained in them: rules are explicitly formulated and apart from processes and procedures.

3. Deliberate knowledge, not a by-product: rules are explicitely formulated and formalized intentionally to capture the basic business knowledge.

4. Declarative, not procedural: rules should be expressed declaratively in naturallanguage sentences for the business audience, the basic constructs of rules are facts and terms.

5. Well-formed expression, not ad hoc: business rules should be expressed in such a way that they can be validated for correctness by business people, to ensure this, business rules are formalized as logical expressions.

6. Rule-based architecture, not indirect implementation: A business rules application is intentionally built to accommodate continuous change in business rules; business rules should be executed in a rules engine; a business rule system must always be able to explain its reasoning.

7. Rule-guided processes, not exception-based programming: Rules define the boundary between an acceptable and unacceptable business activity, exceptions should be described using rules as well.

8. For the sake of the business, not technology: Rules are about business practice and guidance; rules are motivated by business goals and objectives.

9. Of, by, and for business people, not IT people: business rules should be formulated, created, validated and managed by business people.

10. Managing business logic, not hardware/software platforms: rules are more important to the business than are hardware/software platforms. Rules should be organized and stored in such a way that they can be easily ported to new hardware/software platforms. Rules should be easily modified.

Business rules can be interpreted and executed either by humans or by business rules management systems. In the former case, the rules are represented usually using natural language or semi-formal logic-based expressions and have a form of guidelines created by humans for humans. In the latter case, the business rules are represented using a logic-based formalism and are executed using a kind of inference. The same "`piece of knowledge"' can have all three forms. Following example is adapted from [6]. The first form of the rule is a natural language sentence:

A loan may be approved if the status of the customer is high
and the loan is less than 2000 unless the customer has a low rating

The second form is an IF-THEN rule expressed in a semi-formal way:

IF the customer status is high
AND the loan is less than 2000
AND the customer does not have a low rating
THEN approve the loan

IF the customer status is high
AND the loan is less than 2000
AND the customer has a low rating
THEN dont approve the loan

The third form uses the JBoss Drools syntax to express the rules [2]:

```
rule "Approve a loan"
when
        $Customer : Customer (Status == "high")
        $Customer : Customer (Loan < 2000)
        $Customer : Customer (Rating != "low")
then
```

```
        modify($Customer) {
        setDecision("approve")
        }
end

rule "Do not approve a loan"
when
        $Customer : Customer (Status == "high")
        $Customer : Customer (Loan < 2000)
        $Customer : Customer (Rating == "low")
then
        modify($Customer) {
        setDecision("do not approve")
        }
end
```

3 Business Rules Management Systems Architecture

A full implementation of the business rules approach has three components [1]:

1. A methodology for rule management, that is, collecting, recording, validating, assessing, publishing, and evolving the business rules.
2. One or several more or less formal languages for expressing business rules at different stages of their life cycle and for different audiences (business, IT, and computer).
3. A tool set for managing and executing the rules, a Business Rule Management System (BRMS).

The three components are interrelated. The first component is necessary to acquire the business rules. business rules can be created by human expert (according to their knowledge and expertize) or by using data mining and machine learning techniques. Another source of business rules can be internal documents used in the company. People from BR community call this process rule harvesting.The second component is necessary to express the acquired rules in a human readable and/or machine readable form. As shown in the example above, rules can be expressed using natural language, using semi-formal IF THEN statements or using some implementation language. The third component allows to process the machine-readable business rules using so called rules engine. The rule engine typically goes trough the business rules to find those rules that are applicable for given facts – this process is called pattern matching. All applicable rules at a given moment are placed to so called agenda. From here, only a single rule is choosen (using a conflict resolution strategy) to be applied. Such a rule then modifies (by it's actions) the set of facts stored in the working memory and a new search for applicable rules can start. So the match – conflict resolution – act steps iteratively repeat. Fig. 1 shows a general form of a rule engine working in the described way, a so called production system.

Let's consider Drools as an example of a business rule management system. Drools is an open source project supported by JBoss and Red Hat, Inc. (JBoss.org, 2017). Drools is split into two main parts: Authoring and Runtime. Authoring part involves the creation of rules

files, so it supports the knowledge acquisition and encoding processes, runtime part involves the rule-based inference.

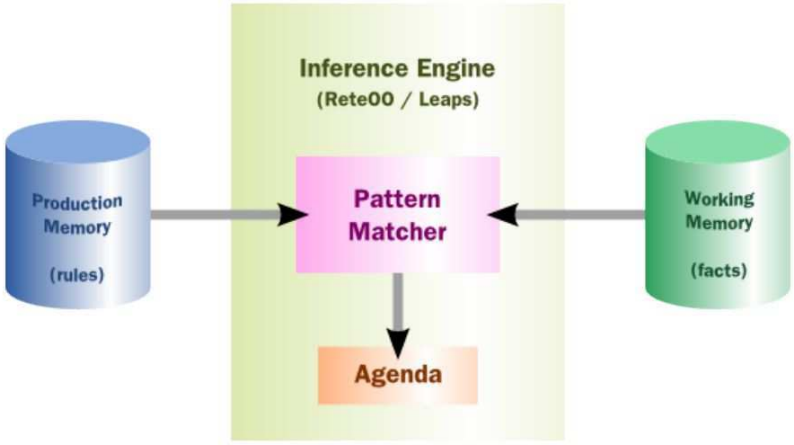

Fig. 1 *High level view of a production rule system* (docs.jboss.org)

Drools works with facts and rules. Fact represents true piece of information, they typically refer to attributes of an object. Rules have the general form

```
rule "<name>"
  attributes
when
    LHS
then
   RHS
end
```

where RHS (left-hand side) consists of conditional elements (CE's) and RHS is a list of actions that can be performed if all conditional elements are true. An example rule in Drools syntax has already been shown in section 2.

4 Similarities with Expert Systems

Expert systems represent the prominent research area within AI in the 70th of the 20th Century. An Expert system is an intelligent computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solution [4].

An expert system consists of two main parts: knowledge base and inference mechanism. Knowledge base contains domain specific knowledge acquired from the experts, inference mechanism is a domain independent algorithm used for reasoning upon the knowledge base. Next part is the working memory that contains current data (questions of the system answered

so far, partial results). All these parts can be found also in the business rules management systems. If run in dialogue mode, the expert system contains also the communication and explanation modules.

We can distinguish two basic types of expert systems: diagnostic and generative. In diagnostic expert systems, the meaning of rules is declarative, i.e.

IF condition THEN conclusion

while in generative expert systems, the meaning of rules is procedural, i.e.

IF situation THEN action.

The inference mechanism of diagnostic systems is used to derive true conclusions (from true conditions), the inference mechanism of generative systems is used to perform actions. So from the expert systems point-of-view, business rule management systems are nothing else but generative expert systems.

5 Conclusions

Business rules management systems borrow a lot from expert systems: the idea of rule-based reasoning as used in generative expert systems, a fast and effective implementation of the pattern matching step, or the general architecture of production systems. Newertheless, some differences remain: expert systems are used in a great variety of application domains while business rules management systems are oriented on applications in business and industry and rules in the area of expert systems are intended to be applied only by an inference mechanism, business rules can be used also by humans.

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Reverse knowledge transfer: A case study

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Abstract: By reverse transfer knowledge gets from the subsidiary to the parent company that can utilize this knowledge to the benefit of other affiliates. Such process drives the results of the recieving unit. The paper describes how marketing knowledge was transfered from Slovak retailer through the parent company to the subsidiaries in the neighbouring countries. Knowledge sharing was supported by the organizational structures, company communication tools and cooperative culture. The subsidiaries in new countries achieved the same benefits that knowledge delivered in the country of its origin. Employee skills toghether with subsidiary environment create the room for generation of the ideas that could translate into new benefitial knowledge.

Keywords: Knowledge transfer, reverse knowledge transfer, marketing knowledge transfer, Tesco.

1 Introduction

Knowledge transfer could be defined as „an attempt by an entity to copy a specific type of knowledge from another entity. [...] Knowledge transfer is about ensuring that efforts provide the desired results (effectivness) and ensuring that the new knowledge becomes embedded within the organization´s fabric (institutionalizaiton)“ (Lucas, 2006, p. 259). Knowledge transfer results in similiar or identical knowledge utiliziation in the second organizational unit while engaging the sender and the recipient. Knowledge flow could have several directions within the multinationals: directly from the parent company to its subsiadiaries, where the subsidiaries tend to be knowledge recipients. Secondly, knowledge could be exchanged among the subsidiaries, that send and recieve knowledge. Knowledge could be exchanged also without the participation of the parent company. Finally, network could be formed from the parent company and its subsidiaries where the headquarters facilitate knowledge flow, especially if the subsidiaries are not willing to exchange knowledge, resp. knowledge exchange is needed to meet the organizational strategic objectives (Lucas, 2006).

The academic research has traditionally focused on knowledge transfer from the parent company to its subsidiaries, resp. from the developed countries to the developing ones. The practice has changed following the internationalization and research and development decentralization which reflected also in the theory that started to study less traditional knowledge flows from the subsidiaries to the parent companies and from the developing countries to the developed states. According to the definition, the reverse knowledge transfer is the transfer of the skills and competencies from the affiliates abroad to the headquarters in a home country. „Reverse knowledge transfer happens from subsidiary to parent, i.e. subsidiary

experiences are transferred to parent companies.“ (Mudambi et al., 2013, p. 49). Reverse knowledge transfer example is the development of the product in the local market that is trasfered to the parent company which makes it available to the affiliates elsewhere.

Some scholars suggest that reverse knowledge transfer is identical to traditional knowledge transfer. The other schools disagree and emphasize that reverse knowledge transfer requires richer activities, more frequent personal contacts, headquarter interventions and a lot more effort in general (Borini et al.). Despite the similiarities of the transfer mechanisms there are much less cases of reverse knowledge transfer compared to knowledge transfer from the headquarters to its subsidiaries.

Vast majority of the literature related to reverse knowledge transfer is covering its antecedents and the influencing factors. Literature does not mention the reverse knowledge transfer practice, the process and the specific cases. We believe that insight into real reverse knowledge transfer cases will add the new qualitative aspects to the existing knowledge base.

2 Objective and metodology

The paper objective is to enrich the existing level of understanding of reverse knowledge transfer. Building on the reverse knowledge definition, we aim to verify the utilization of knowledge transfer from the subsidiaries to the parent companies via studying such cases, analyzing the driving factors and the benefits for both – subsidiary and the organization. Our findings will form a further perspective to the theme that has so far been studied in a general level, not by assessing the reverse knowledge transfer cases.

The applied metodology of an in-dept case study is analyzing the whole reverse knowledge transfer case. Three cases of reverse knowledge transfer coming for well known retailer will be looked into. The case study suggests that the company is using reverse knowledge transfer to build synergies and support its competitivness. At the same time we realize that an enlargment of our research would allow to form more generic findings and implications related to reverse knowledge transfer utilization in the multinationals.

3 Case study – Reverse transfer of marketing knowledge in Tesco

Use Tesco is a well established retailer in Slovakia offering grocery products and various services incl. mobile phones, financial, pharmacy, optics. Tesco in Slovakia (Tesco SK) is a member of Central Europe cluster that consists of: Slovakia, Czech republic, Poland and Hungary. Marketing management is based in Prague, headed by marketing director for Central Europe with following responsibilities: (1) communication, (2) research and pricing, (3) innovations and the deployment of digital media. Each stream is lead by the respective manager, who is responsible for the performance in all four countries. Each stream is further structered into few specializations.

The structure that is organized in a way that a manager is leading a team of speacialists located in four countries and it is supporting the cooperation on Regional level. Multiple communication tools are available to employees – various online messengers that can carry out audio and video transmissions, e-mails, telephones, teleconferences, videoconferences, international and individual personal meetings. The employees use these communication opportunities vastly in their daily work.

Tesco SK has developed several improvements of marketing processes and campaigns, that were recognized by the headquarters in Prague and introduced in the remaining Central European countries. These marketing innovations were driven by the specific requirements of Slovak market as well as the willingness of the local marketers to deliver better shopping environment for the customers, more attractive offers and modern services. Three such marketing projects that significantly enhanced Tesco service for customers and originate in Slovakia will be introduced further: improved communication on POS materials in the stores, new way of getting customer feedback on Tesco service and program supporting cooperation with local suppliers.

The decision about the unification of POS materials used in the stores in Central Europe was taken at the beginning of 2017. The key objective was to harmonize the look and feel of the stores and achieve synergies while building Tesco brand. The project was led by Czech team dedicated to BTL communication that encompass the marketing materials used in the stores.

Czech team developed nice universal design. POS materials were visually attractive, easy to understand and implement. The graphics was aesthetic, impactful, clearly differentiating the promo mechanics: price promotion, Clubcard offer, permanently cheap prices, Tesco exclusivity, novelty, clearance and others. POS material set covered all communication positions within the store: power aisle by an entrance, action alley, aisles for regular product placements, counters with meat, fish, provision and cheese, bistro, bakery, fruit and vegetable and the rest of the moduls and their promo ends. The POS set contained: strips, wobblers, bubbles, leaflets, hotspots, shelf talkers, banners, pallet wraps, chalk boards, shelfage lables.

Although the materials were very nice, eye catching, navigating the customers, easy to work with a weak price message was identified by Slovak team just few weeks after the launch. Some image POS materials were communicating solely the promo mechanics such as promo, clearance, Tesco price while the particular prices were only written on the small size shelfage labels. As the price is the key decisive factor for the customers in Slovakia, the need to advance POS materials was defined. Slovak marketing team initiated a local adaptation of Regional POS materials in order to inform the customers about the prices of the products and eliminate the potential purchase barrier raising from unsufficient price communication. Marketing team intensively cooperated with the store managers who know the possibilities of the stores to print prices on POS materials directly in the shops. Each POS format was adjusted so that the stores could print the prices directly on POS or on additional piece of paper that is placed next to the respective POS. In general the stores are able to print upto A3 size, thus pre-defined arrays were created on the POS materials so that the stores print the respective price therein. The bigger size POS materials were changed in a way, that either vertical or horizontal A4 price printed by the stores could be added to. The active communication with the stores about the technical possibilities and search for optimal setting were quite a complex and challenging steps while developing the adjusted communication on POS. The outcome of the cooperation were POS materials based on a look and feel of the initial development, however enhanced by the improved price visibility, incl. all prices the customers are usually interested to see (old price, promo price, discount in %, unit price). It helped navigate customer, it informed about promo mechanics and also about pricing which are crucial information pieces for purchase decision. Following the customer research the final design of POS materials is well percieved and according to the feedback from the store managers and buyers enhanced communication prevents declining sales resp. makes buyers organizing better offers for Tesco customers every day.

The improved POS material set was well recieved by the headquarters and also by Tesco teams in the rest of the countries of Central Europe. The strong point was seen in the power of price communication and compatibility with the printing opportunities of the stores. All three countries within the Region applied the original Slovak templates of the POS materials only with slight adjustements according to their local specifics.

The objective of Tesco is to provide the best possible service to its customers. In order to track the fullfilment of this goal Tesco monitors the customer satisfaction in the research conducted by British agency InMoment. The study used to use face to face interviews in the stores, the interviewers visited each Slovak store three times a month and interviewed the customers after the payment at the cash desk area. The questionaire was aiming at finding the customer satisfaction, the interviewers were inserting the respondents´ answer to tablet. The process based on the manpower was seen as old and expensive and according to the stores with the bias risk as the interviewers could potentially ask the questions with a different tone of voice. This aspect was considered servious since the research results serve for the stores evaluation.

The solution was created in Slovakia. Following up-to-date IT opportunities online research was seen as an interesting option. The Slovak team and the research agency developed an online questionaire that replaced the interviewers and was reachable from the Tesco website. The questionaire is testing the same topics as the interviewers, but on top allows the respondents that have cameras to shoot a message to Tesco in the form of a simple video. This solution is more flexible, it forwards the claims and positive feedback to the respective store faster, the results are available in the shorter time and the potential impact of the interviewers is eliminated.

In order to successufuly change the way of gathering the customer feedback it was necessary to navigate the respondents to the respective microsite. Online way of the research was promoted on adverisment in Tesco stores and in the leaflet. The participating rate of 50 respondents per store in average is slightly below the rate achieved by personal interviews, but it is sufficient to assess store performance. The simplicity of the questionaire and motivating the respondents who can collect extra Clubcard points and have a chance to win 150€ are supporting online study.

The biggest advantage of modern online research on Tesco customer feedback on service is the increased flexibility and speed, objectivity as each respondent reads the same questions, customer reward and chance to win and mainly much lower cost. The initial investment into the development of online platform and robust advertising in the stores was ofset by lower maintance fees compared to the labor cost of the interviewers. The change in research process, the advantages of online platform was shared with the headquarters. The positive cost-benefit analysis inspired Tesco in the other countries within the Region to follow the new way and change to electronic research. Czech republic, Hungary and Poland implemented online research with its design and set up and also the advertising campaign including the motivation of the customers with extra Clubcard points and prize. Nowadays, Tesco in Central Europe collects the customer feedback online, thus saves the cost that could be invested into the better service for the custumers.

Tesco is the biggest retail chain in Slovakia. It runs two central warehouses that supplies the products to its 180 shops within the country. The majority of the stores are big hypermarkets having an area of several thousands m2. The sortiment is managed in a way that all customers have an access to the products of the same quality and at the same price level. The price pressure

and the request for huge stock volume are in favor of international suppliers that can guarantee constant stock level and stable prices. On the other hand, the range from the local producers is very limited which is heavily commented by the third parties and the authorities.

Tesco, as the market leader, initiated the program that brings the product from local manufacturers onto its shelves. The commercial team established a pilot with local producers of fruit and vegetable, meat and provision, fish, diary and bakery. After the contract sign off they were allowed to supply their products directly to Tesco stores in their region. Few shelves were dedicated to the products of local small and medium food producers. Furthermore, communication campaign that supported the sale of the goods of Slovak origin was created by Tesco and was run in media and also in the stores and Tesco leaflet.

The project made the products of local food producers available in Tesco stores next to renowned international food brands. The regional producers appreciated an opportunity to deliver their products to Tesco stores. The project supported positive Tesco image, increased the awareness of social responsibility of the chain and its relationship to the local communities. This approach was very much welcome also by the authorities, Ministry of Agriculture.

The project on cooperation with regional producers was explained to the headquarters in the Czech republic. The success of the project that strengthened the credibility of Tesco brand made other Central European countries introduce it localy. Czech republic, Hungary and Poland replicated marketing materials, copies while them adjusting according to local context. Know-how related to the management of dozens of local producers and the way of handling increased logistics complexity stood for the greates knowledge benefits they recieved. The business cooperation with the small and medium producers was in each country well recieved and contributed to strengthening Tesco market position.

The three cases of marketing processes stand for the successful projects that delivered positive results: advertising materials with positive impact on the customers, the savings on customer satisfaction research, widen range thanks to offering the goods from the local producers that is broadly appreciated. The tangible benefits that are captured in the research results and the cost saving made Tesco in the other countries introduce the same initiatives. The detailed information about the projects and their outcomes were presented to the headquarters, communication was done via e-mails, phone calls, videoconferences and also personal meetings. Reverse knowledge transfer helped other countries launch attractive projects at minimal costs and benefit from their positive effects.

4 Conclusion

Tesco has an organizational structure that covers four countries which promotes cooperation on a regional level. The organization supports knowledge exhange and knowledge utilization in the region. The knowledge flow is supported also by modern technical equipment that is available to all employees. The sharing culture is incorporated in the company values and many employees also from lower hierarchy levels are part of international teams. Tesco marketing strategy emphasizes synergies and commonalities, which does not necessarily mean that all of the campaigns are developed solely by the headquarters. The initiative and creativity of local marketing teams is adding to central ideas – Slovak team is adequatly active.

The reverse transfer cases suggest that unique marketing activities are being developed when the desired practice is missing within the organization. The generation of new knowledge is

supported by willingness of local staff to advance the existing way of working and by the ideas coming from the external environment. We showed that Slovak knowledge can help the whole multinational when being utilized by the other subsidiaries. Our study is in line with the research organized on 293 subsidiaries of Italian multinationals by Mudambi et al. (2013), that implies the greater the cost imposed on the MNE by the non-use of the subsidiary´s competencies the more effort the headquartes is willing to undertake to acquire knowledge while conceding power and influence to the subsidiary.

Marketing ideas from Slovakia may drive innovations which are transfered to the parent company and other subsidiaries and improve the customer service and competitivness of the corporation. Even if marketing has often to take the local context into the consideration, the cases prove that some principles are universal, thus could be transported to the other markets. In Tesco case the headquarter has facilitator role and coordinates knowledge flows.

When studying reverse knowledge flows, it is recommended to watch the effectivness and the benefits for all involved parties. In our cases all of the recipients enjoyed the same positives as knowledge donator, moreover they avoided the development costs. The process of reverse knowledge transfer did not require substantial cost, only affordable amount of time for communication of the cases. Slovak marketing team did not gain reward or acknowledgement due to sharing of their knowledge since knowledge exchange is treated as daily routine. Reverse knowledge transfer increases knowledge base of the company and in case of Tesco the balance between getting and giving is achieved.

Knowledge which is suitable for the other subsidiaries is worth sharing. Such ideas can initiate or represent the final solution for the other organizational unit. The management are often able to reveal the potential of new knowledge and the possibilities to utilize it elsewhere with or without necessary adjustment. We aim to further study the situation of reverse knowledge transfer from Slovak subsidiaries to their parent companies abroad to understand which knowledge they are contributing to the organizations. The initial cases indicate that the subsidiaries from Slovakia do add to corporate knowledge base thus support the overall performance.

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University Leadership and Role Distribution

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Abstract: Universities are large corporate structures where many of the operation functions that are imperative for the effective operation of the university are not directly connected to education or research. Therefore, the structure of these managerial functions requires a variety of abilities and skills in which typical academicians are not trained and experienced. The specific aim of our paper is to dispute a Central Eastern European (CEE) conviction that only academicians can become appropriate academic leaders and occupy higher functions in the university organizational structure. Since a majority of positions at universities are knowledge workers, our paper uses a knowledge management perspective in our analysis of the university workforce. In pursuit of this, the following questions are discussed:

Can the expected abilities and skills be categorized in cluster university knowledge workers? What do we expect of individuals belonging to a particular cluster? Are knowledge workers of every cluster present at our universities in sufficient proportions and numbers? Are these knowledge workers recognized and adequately rewarded?'

Our analysis does not provide an optimistic outcome for universities in the CEE and in particular the Slovak Republic due to the intransient position and the limited desire and motivation of the academic community to transform its traditional structure.

Keywords: university knowledge worker; university human resources; university management; balancing explicit and tacit knowledge.

1 Introduction

Traditional managerial approaches are concentrated on people as manpower, not on exploitation of their intellectual capital. Peter Drucker [1] was the first one who pointed to the fact that people's knowledge is another production power and awarded the persons who "think for living" by the term "knowledge worker". These people's primary source of income exploits their cerebral capacity and intellectual capability. Their position in the production process is very specific – they are rarely involved in it directly: which is a logical consequence of work distribution.

From this point of view, the situation at Slovak universities, and similarly at many universities in CEE, is not consistent with Drucker's perspective of managerial positions. The university top management is not only selected among educators – they are expected to continue their education and research work in parallel with their executive functions. Such an approach is not consistent with the belief that the main aim of work distribution is specialization – the process of concentrating on and becoming an expert in a particular subject or skill. These employees of CEE universities are expected to be simultaneously an educator, a researcher and a top manager. Thus, these individuals can hardly develop his/her knowledge and intensify his/her skills in all three directions. In addition, the Slovak University Law [2] indirectly

mandates this. Rectors and Deans are elected for the periods of four years, and their deputies are nominated for the same period. All of them can hold the same function for one more four-year period only. Since their future destiny in the university environment is unspecified, they continue acting in the two other positions. As a result, these individuals often do not even try to become experts in management. Furthermore, the old adage applies to the Slovak university manager: 'If you try to do too many things at once, you ultimately will not be successful in any one of them'. Thus, due to the academic administrators' intensive managerial duties, both their skills as a manager and their expertise in education and research suffer.

2 Managing Knowledge Workers

In companies, knowledge workers occupy a variety of positions: designers, developers, marketing managers, etc. Each of them requires different knowledge, skills and experience influenced by their education, position, and practice. Knowledge worker positions also vary substantially and, consequently, shape the individuals occupying them. Due to this, a knowledge worker cannot be shifted from his/her position to a new one without detailed consideration whether the person is capable of adapting to it.

Traditional managerial approaches address organization of production. Thus, they do not fit a knowledge worker's outcomes, which are often invisible or virtual [3]. Traditional management can be (to a certain degree) applied to explicit knowledge extension and depth – it can be tested and measured, which can hardly be functional in handling the knowledge worker's tacit knowledge. Unfortunately, élite knowledge workers are "selling" the latter one, thus, moving the expert above average. Mládková [4] responded to this challenge by presenting tailored methods of approaching them, where the knowledge workers' typical driver is implementation of motivational approaches over orders. In this, Mládková stresses that excellent knowledge workers are more motivated by difficult tasks than extrinsic rewards.

To find an appropriate motivation strategy is not possible without taking into account specifics of the particular branch of industry and the typical structure and functions of its knowledge workers. For example, Bohumelová and Hvorecký [5, 6] applied Knowledge Management to the field of exhibitions in museums and art galleries. Rábeková [7] exploited a similar dialogue-based approach to adult education. She designed and developed a method of facilitating educators' potential via their collaboration with their would-be learners. In accord with her methodology, the learners become co-designers of their course – they collaborate on designing the content and educational approach. This method is appropriate for training of small groups of professionals in a narrow field relevant to their expertise [8]. Šestáková [9] points to the importance of distinguishing between different approaches to knowledge development for specialists executing higher positions in banking and finance.

Compared to the preceding examples, universities in the Slovak Republic (and other universities in the CEE) represent more complex bodies with huge numbers of specialists from very distant and diverse fields, often focusing on very broad and complex problems that border on the edge of existential bodies and knowledge. Solving difficult problems requires setting up very specific conditions and their systematic, uninterrupted development. Nonaka and Takeuchi [10] denoted the term "ba" as the environments designed and developed for knowledge workers to originate, dialogue, exercise and systemize their knowledge.

In complex environments (which universities undoubtedly are), building appropriate ba's represents a key to success. Consequently, a substantial portion of knowledge workers' effort

must be devoted to their design and development. To maximize the outcomes, work distribution is needed. To outline its directions and to classify them is our paper's aim. Thus, it might help us to understand better how the university goal-related duties can be accomplished to the benefit of its entire community.

In our paper, we will primarily concentrate on two problems of university management: first, on leadership, and second, on academic role distribution. In order to tackle the first problem, we will explore distinctions between book-smart and street-smart individuals. Using Kess' typology [11], where he divides knowledge workers into six categories, we will look at university workers' role assignment, where some members design and develop university's ba, while others exploit their outcomes to attain the maximum results in education and research. Without their mutual collaboration and information exchange, universities do not reach their expected standards of quality and high performance.

3 Book-smart vs. Street-smart Leaders

In this analysis, we will look first at: book smarts vs. street smart leaders.

At Central Eastern European universities, there is a consensus that the leaders must come from the university community on the principle *Primus inter pares* (first among equals) – the traditional principle presuming that the leader of the community must be elected from it. It refers to the Middle Age continental Europe with universities as the only islands of freedom of speech [12]. To protect the privileges and to minimize the risk of their loss, the promotion to leading positions within the academic community was based on a stepwise promotion, that being that candidates were only selected from those "consecrated" i.e., those whose loyalty and steadiness were vetted beyond any doubt. As universities have been built upon academic excellence, the leading positions were and in Central Eastern Europe still are occupied by individuals with high academic achievements. The Urban Dictionary [13] denotes such individuals as "book smart" ones in comparison to the opposing group of "street smart". (This is not to say or infer that a book smart person can't have street smartness, but frequently there is a focus on one or the other).

The concepts and their definitions were originally developed to explore the "figuring" of smartness through the perspectives of the marginalized youth [14] and to capture why some of them are regarded as reputed personalities and/or leaders. The concept of street smartness is a direct challenge to the dominant discourse of smartness as it operates in schools and universities and uses a completely different criterion to measure it. To the marginalized youth, "street smarts" are more important because they are being able to maneuver through structures in their lives such as poverty, the police, street culture, and abusive "others." Street smart individuals' intelligence is practical. It has been gained using their specific experiential way, primarily through trials and errors or by self-learning. They tend to be impromptu, are ready to take risk and capable to solve sudden problems in the event of crisis. A street smart individual has a lot of common sense and knows what's going on in the world. This person knows what every type of person has to deal with daily and understands all groups of people and how to act around them. He/she also knows all the current changes going on in the "streets" and everywhere else and knows how to make his/her own right decisions, knows how to deal with different situations and has his/her own independent opinions. He/she occasionally sets up his/her own rules of game which are then accepted by his/her neighborhood by the power of authority.

Conversely, the school smart beings are valued by "well-mannered" communities especially for their predictable and systematic behavior. They have highly developed analytical skills obtained during their education at schools and universities and further professional development. They think things through, tend to be organized and thoroughly prepared with having pre-elaborated back-up plans in case something goes wrong. During the years spent in their profession, they learned to rely on their expert knowledge. In extreme cases, they presume that their systematic and well-elaborated methods applied in their beloved area can equally be applicable to every life situation. As a result, they often fail because the situation requires a substantially different approach. As an example, let us mention a university president – a former marine biologist – whose every example in management is related to dissection of a sea animal.

The antinomies and similarities between those two natures can be learned from Blair's book [15]. This text shows that entrepreneurs have to become (at least to a certain degree) street smart in order to successfully compete in their "entrepreneurial jungle". Universities are organizations and, despite their distinctions from production-oriented bodies, they share many features with them. Likely, the most important one is the necessity to compete with all other entrants present in the same field of activity. This also means that academic leaders have to possess a certain degree of street smartness. A good academic leader has to be familiar with all the current changes going on in the "streets" (i.e. not only within his/her internal academic community but also in its surrounding world), to have his/her own independent opinions, to be able to formulate and take his/her own right decisions, and to have the skill to deal with evolving situations including needed compromises. It is necessary to add that many of these skills are also part of university courses. Thus, it implies that compared to "pure" street-smart leaders, the street smart university managers do not need to rely on their uninformed experience only; they can exploit knowledge stored in books and other sources. However, in reality the book-based knowledge is insufficient for excellence in leadership (it is often the debated topic whether leadership can be taught). If it truly could be obtained through books alone, every attentive reader could become a top manager. In business life, there are many situations in which fully-rational decisions do not bring optimal solutions. Also, data show that the managers apply rationality in their decisions much less frequently than the readers of textbooks on Management might think [16].

4 Role Distribution Among Knowledge Workers

Using the Knowledge Management terminology [17], book smartness is primarily based on explicit knowledge whilst street smartness benefits predominantly from tacit one. Prospective academic leaders must demonstrate both of them in accord with their positions and situations they face. The dominance of book smartness with its dominating accent on explicit knowledge and suppression of intuition becomes a worldwide issue. The numbers become a "golden calf" to be praised by scientists [18]: "*In the Netherlands, counting output started off with the number of publications, then international publications, after which only English-language publications, counter hereafter articles in high-impact journals, and eventually often-cited publications (leading to a high 'h-index').*" All this leads to the suppression of intuition, creativity, comprehensive and longitude thorough analysis and synthesis.

In this section, we therefore study the relationship between explicit and tacit knowledge. Many of the readers of this paper are aware of the "knowledge iceberg", where Nonaka and Takeuchi in their book The Knowledge-Creating Company [19] highlight the distribution of explicit and tacit knowledge. Following our above specification, by explicit knowledge we

designate book-smart-oriented knowledge as facilitating, systematic, well-organized knowledge; i.e., "true-academic". Tacit knowledge is knowledge which is more intuitive, difficult to describe n level of risk-taking. Exploiting their proportions in an individual will help us to form several levels of them, make smoother distinctions between "pure book smarts" and "pure street smarts" and demonstrate their influence on the university management.

Kess [11] identified six categories of knowledge workers and distributed them by different proportions between their tacit and explicit knowledge – see Figure 1.

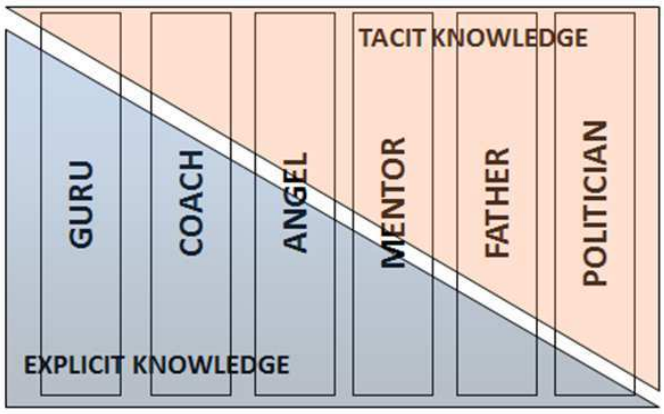

Fig. 1 *Kess' typology of knowledge workers*

A. Guru

Gurus have deep professional knowledge of their specific area. Their interests are strongly connected to his/her expertise and may not go far beyond it. Their long and rigorous expertise helps them to solve their professional problems in a creative and innovative way – more efficiently than most specialists working in the same field would do. Their tacit knowledge is both extensive and intensive in their domain of expertise but may not be applicable in areas outside it. This makes the gurus a bit "autistic". As a result, they are quite impractical in solving problems beyond their own specialization. When they are exactly defined (mostly as a narrow field of science or technology), they demonstrate their high qualities.

The guru has a book smart oriented personality. As a pure thinker, he/she is entirely focused on his/her field of expertise and is devoted to it. (Often, he/she has never been required or expected to perform anything else.) The amount of his/her field-oriented knowledge can be tremendous but it is primarily tied to his/her daily routine whatever "routine" it is. As an indirect result of his/her external interests, he/she tries to measure all the world by the criteria of his discipline and, whenever it is possible, expresses his/her opinions by numbers or formulas. In the University environment, the individuals with this style of thinking create and enforce scientometrics [20] as a quality measure only and are convinced that it is the best metrics. Often, their most effective place within the universities is laboratory settings, where the university will benefit from their knowledge and they are most happy as their expertise will be maximized here. Interestingly, even gurus working in humanities tend to stress exact components of their discipline. They concentrate on introducing solid and rigid terminology and on defining and utilizing strict rules of manipulation with the terms. This helps them to advance and promote the formalized subdivisions of humanities. Their systematic character corresponds to their orientation and mentality.

A problem with gurus can be their unwillingness to share their knowledge with their neighborhood in order to hold "knowledge power" i.e. a disciplinary power [21] based on strengthening their own position by keeping certain knowledge exclusive for themselves and by prohibiting others from obtaining it – they keep it close to the chest so to speak and use it as a source of power.

B. Coach

The coach is also a specialist in a narrow and well-defined discipline but – unlike a guru – he/she also comprehends the importance of making connections between his/her field and the rest of the world. He/she is interested in them, in their mutual intersections and their reciprocated influences. He/she is capable of innovativeness, not only inside his/her specialization, but also in creating new links between it and its surroundings. Due to this, the coach understands informal (unspoken) requirements on his/her field's outcomes applicability. It makes him/her capable to tailor these outcomes to their future users' needs with respect to their qualification, mentality and habits.

Coaches are those who bring gurus' results to life. The combination of their expert (explicit) knowledge with knowledge relevant to their field (tacit) bridges the newly gained guru's knowledge with partner fields such as engineering, technology, psychology, marketing, education and others. Coaches are often ready to take a step out (of their domain and specialty) and search for applications of their "mother" specialization. Often, they can ignite interdisciplinary research or open a new research field. While gurus' dreams are discoveries, coaches are satisfied with inventions because they look for prosperity coming from new knowledge. At universities, they often benefit in positions oriented towards collaboration with the university community partners in industry, social services, health care, education, etc.

The coaches' personal characteristics are highly valued around the world because they communicate their university's results to the public. Unfortunately, it does not apply in our universities in Slovakia. The accreditation criteria in the Slovak Republic (and often other CEE nations as well) expect everyone to have a narrow orientation. The accreditation bodies do not support interdisciplinary activities [22]. Due to its standards, the Slovak accreditation commission often refuses to recognize an interdisciplinary-oriented research publication because the paper does not fit within a clearly defined "box". As a result of this indirect pressure, interdisciplinary studies have been substantially reduced during the last decade. Similarly, it often discounts and neglects the value of inventions, new surgery methods and other innovative approaches and techniques. For example, a coach who is absent at Slovak universities is a "textbook writer" – an individual capable of presenting his/her field of knowledge in the way relevant for novices. Again, this function is not adequately valued by university officials and does not substantially contribute to the person's promotion. Surprisingly, uninformed outside observers may get the opposite feelings because the publication of learning materials (named "skriptá") is an obligation for promotion to the docent or associate professor position. However, the applicant can frequently write material of any quality – there is no rigorous checking and balances, so many works of low quality, sometimes even plagiarized, are passed through.

Unless the Slovak tertiary education system develops incentives to activate and incentivize its potential coaches, no progress in this area will become noticeable in the near future. The coaches of all directions will remain extinct species.

C. Angel

Angels are facilitators, so called engines of progress. They do not need to belong among the top field specialists; they build their optimal work conditions. Their main role is to facilitate the development of appropriate ba for other knowledge workers – "true" field specialists (gurus and coaches). Their contribution to their particular field is made indirectly by assigning needed resources or by their capability to acquire them and to control their effective and efficient utilization. The angel's tacit knowledge must include a broad understanding of their surroundings and the disciplines in the field and the ability to identify areas in which his/her team's efforts can be expanded in ways which will bring the maximum benefits. The angel's determination is critical for the success of the team.

Angels are another extinct species at Slovak universities. As stated above, they are the persons taking care of the optimal working conditions for others. They should systematically build working environments, enhance positive atmosphere and build and develop organizational culture for all partners. They do not need to be top experts but have good orientation in the field. They must possess organizational skills and emotional potential to create friendly atmosphere to maximize the efforts of the team and to "sell" them to the community in order to gain further resources for the team's growth, progress and prosperity.

Universities in the Slovak Republic and elsewhere in CEE nations which want to prosper should open relevant positions and assign appropriate persons who could serve as potential "Angels". For example, former researchers have solid and well-consolidated knowledge making them capable of estimating future trends and looking behind horizons. The university should give these individuals decisional power (including finance) to support the university's progress in promising areas selected by them. Often, no additional new positions would need to be created, e.g. when professors emeritus could be used in this capacity. Angel's roles could also be executed by the heads of departments. Unfortunately, in Slovakia, the decisional power of department heads is very limited by the University Act [2]. In addition, the budget of Slovak public universities is stated separately for every calendar year. Thus, this restricts their freedom of long-term planning and may make angels' long-term visions obsolete.

D. Mentor

Both angels and mentors are characterized by their balance between tacit and explicit knowledge. While angels are oriented to the development of their field of knowledge, mentors are typically willing to share their knowledge with the community. In this way, they prepare the followers, who will presumably join their field of interest. Their tacit knowledge must, therefore, include the ability to select gifted candidates. They will deliver their knowledge, experience and skills to them. The mentors also contribute to the development of their field by organizing its "marketing" i.e. by presenting it to the public. (Here, the term "marketing" is used in a very broad sense describing any promotion activity and publicity related to the field/product/idea.) By their daily activities, the mentors guarantee that the field will continue to exist and will remain vital.

In a way, the mentors' key role is to guarantee that the university will fulfill its functions at the expected level of quality, i.e. they make the future come. As educators, they pave the road to the massive application of gurus' and coaches' knowledge by designing and developing new study programs, by verifying vitality of their ideas, by spreading the concepts among laymen, by designing, developing and trying new teaching methodologies and performing experiments in laboratories, and so on. They cooperate with gurus in order to perform their respective activities in their intended (simplified, public-oriented) ways and communicate with angels, who plan and sponsor these activities.

Often, the mentors also collect information from external sources – research centers and leading universities – in order to facilitate design of an innovative and competitive university vision and to develop a realistic strategy for its implementation. The university must have an army of high quality mentors to fulfill its functions in both education and research. To keep their faithfulness, their efforts should be regularly recognized and adequately rewarded.

E. Father

The father represents the "face" and the historical background of the business. For his/her organizational neighborhood, he/she serves as a symbol. (In our interpretation, the "family" can be any team glued by its members' collective vision, values and collaborative activities.) Father's knowledge is strongly combined with his/her "family" values. The "father's" sheer presence ensures to the outsiders that everything is as it should be, i.e., demonstrates historic continuity. As Kess [11] shows, fathers play their critical role in two moments of life: during launching of the company and during its depression. In the first case, their enthusiasm can inspire the others and lead them towards new aspirations. In the second case, he/she has to demonstrate the team's vitality and engage it in its regeneration. Hence, the father has to be a compassionate leader. In academy, he/she has to be capable of setting up a holistic vision across the university's research and study fields.

Currently, one can hardly speak about any true fathers at Slovak universities. "Being a father" is a lifelong duty and must be taken by a person who is ready to dedicate his/her soul to it. For that reason, fathers are quite exceptional in all organizations. In addition, at universities, another problem arises. Due to the size and complexity of these structures and organizations, it is not easy to find a person with a vision covering the entire (or at least substantial) field of their interests. For this reason, he/she can hardly be found among book-smart persons. To understand and properly interpret the mutual interests of many groups with frequently contradicting interests, a street-smart personality is required. Therefore, it implies that the university top management should be selected from among fathers.

In Slovakia, as well as other CEE nations, this is a difficult task due to legislative mandates. The University Act [2] limits duration of academic functions to the maximum of eight years. This same act also gives significant power to self-governing bodies (the academic senates). One can express it as follows: "*Rectors and Deans are responsible for the University but have no power while academic senates have power, but no responsibility*" [23]. The fathers can, therefore, lack the power to implement their visions. They can manage them under the presumption that they persuade the academic senates to follow their visions. Unfortunately to them, many Slovak academic communities are conservative and not ready to leave their "comfort zones". Consequently, they are not ready to accept those visions which threaten to disrupt the status quo.

Currently, a new national strategy of education named Learning Slovakia is under preparation [24]. Hopefully, it will give more autonomy to universities. This could ignite (at least some) universities to form an organizational structure which simplifies implementation of their fathers' visions. Hopefully, some "fathers" capable of designing and implementing positive visions still live and will elevate the system.

F. Politician

The last category of knowledge workers identified by Kess [11] is the politician. For Kess, politicians have to have substantial knowledge of local, national and even international policies relevant to their business operations. In organizations, they lead the varied bodies of the entire

company (or of its relevant part). They communicate on behalf of their groups and present their interests to their surroundings. The role of politicians is to "open the door" of a particular business to the society, e.g. by building demand, getting public and private sources, as well as making steps towards changing legislation in the directions suitable for his/her business. It all implies that he/she must have excellent negotiation skills, too.

The politician has to be capable of creating the organization's long-term visions and of implementing short and long-term strategies. The politician does not need to be capable of solely formulating these strategies, but he/she must be a key voice in helping to shape them, and very importantly, in communicating these strategies both inside and outside the organization. The true politician puts an equal sign between his/her personal success and the success of the vision he/she (re)presents.

Among all types of knowledge workers, the politicians' dependence on their tacit knowledge (e.g. on instincts and intuition) is the greatest. In order to obtain quick and short-term gains and results, they must be capable of performing qualified guesses which must have a high probability of success. These estimates should address social trends, business opportunities and risks, market trends, future innovative technologies, areas of investment and others. Since not all of the guesses will be correct, they must be capable and able to orient themselves in unexpected situations and to find the path to navigate through their mistakes and troubles.

5 University as a Collaborative Workplace For Different Types of Knowledge Workers

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Based on the above cases of book-smart gurus and street-smart politicians, one can easily guess that Kess' knowledge typology predetermines success of a particular type of knowledge worker in a particular position. The human resources policy at universities should respect the typology in assigning people into their positions. Not doing so would lead to their individual discomfort and sub-optimal performance.

For example, the gurus are "pure thinkers" focused on their field of experience (and not looking much around). The positions of leading researcher, as previously mentioned, are appropriate for them. In such a role they can concentrate on their topics and exploit their explicit and field-oriented tacit knowledge to the maximum. They will not be troubled and distracted by other duties. To create optimum working conditions for them should be a duty of others, e.g. coaches within their field of expertise. In contrast, placing such people outside their narrow scope of knowledge would require them to change their orientation and might result in unwanted problems. In this case, they would most likely continue applying their formerly learned routines to the new field (mistakenly) presuming that they are omnipotent and applicable to all life situations. The usage of scientometrics as an omnipotent measuring method of research, technology and innovation outcomes is a typical example of such a faulty practice. It neglects the fact that research publications must have their added value(s) exceeding their sheer existence.

This leads us to proposing a model of role distribution at universities. Its application presumes that the current management is able to recognize the potential of its knowledge workers, to motivate them, to select the best fit for people in respective positions, and to organize their optimal collaboration. Thus, following the dictum for [4], knowledge workers

can't be ordered to execute a particular task; they must be invited to join the respective team(s). Therefore, the university processes must be based on a voluntary process with a focus on intensive collaboration among its knowledge workers. In the existing university environment, the model should work as follows:

- Fathers propose their vision of the university development; for example, establishment of a new study program or research field. The motivation or impulse to do so will likely come from coaches who have discovered new opportunities for the university's activities due to their communication with gurus and mentors and their (coaches') capability to excerpt innovation elements from their notes.
- Politicians evaluate their suggestions and decide which of them might be worthy of "investment", i.e. of their implementation as a new element of the university's profile.
- The fathers then invite coaches to design the research or educational project. The fathers' responsibility will be to build bridges between existing (traditional) fields and the proposed ones, in order to find appropriate "marketing" strategies, as well as to motivate relevant candidates to join the concept – especially among gurus (in the case of research projects) and mentors (for study programs).
- When the vision is approved, politicians and fathers invite angels to start forming conditions for its implementation inside the university (including inviting appropriate external staff to relevant positions). The politician's role will be to find external financial and organizational support for it. (That's why the marketing strategies must be already prepared.)
- When the new field gets its final green light and relevant ba's have been built, gurus and mentors are invited to accomplish the vision.
- Eventually, the loop can start again.

Notice that the model defines the roles slightly differently. For example, the father is unlikely the founder of the university. As the lifespan of universities is counted in tens or even hundreds of years, he/she is rather the person who fulfils the father's role of intensive constant support: He/she guarantees that his/her university "family" will not come into a recession or, if so, it will get out of it and prosper again. He/she is, therefore, a person guaranteeing that its academic trek will follow the needs of the society, lead them and benefit of them.

Similarly, the politicians should set up the university policies and not get involved in politics made by political parties at the national or regional level. On the other hand, keeping the appropriate numbers of fathers and politicians is a condition sine qua non for the academic institution. Their abundance might lead to struggle, possibly "wars", among them – with disastrous consequences.

On the other hand, all study branches and areas of research should have their own gurus, coaches, angels, mentors and fathers. They will guarantee their development in their respective academic fields. To progress, they should cooperate with each other on the development of interdisciplinary areas. There is no reason to waste their precious time by internal struggles. Sooner or later these would be reflected in the university image as shown in [23].

In reality, the role distribution in the above meaning does not exist at Slovak universities. Their traditions (verbally also expressed by the accreditation rules [22]) expect each and every academician to become a guru in his/her discipline. This community mindset discourages potential and appropriate candidates to aspire to other roles "until they reach the guru status".

Then, it is usually too late to reorient the person's knowledge, skills and mentality as the following examples indicate:

- A politician cannot stay in the position of a true guru. The guru must be strongly focused on activities in his/her field of professional knowledge. As every field develops quickly, he/she will soon lose the contact with its limits and stops being a guru.
- A guru does not fit the role of a politician. The politician must be equally open to the needs of all university branches. He/she cannot prefer one towards the others – conversely, he must design and develop the optimal opportunities for the most prospective ones, perhaps by lessening those of his/her "parental" one.

All this indicates the inevitability to educate all categories of knowledge workers. The process is to be long-lasting but should start as soon as possible; otherwise, no progress will be made.

6 Knowledge Workers' Leadership Duties

The described typology can serve as a framework for the human resource departments of those universities which wish to become Learning Organizations [17]. Their organizational learning should primarily concentrate on the most urgent challenges [25, 26]:

- **Recent failures and their remedy:** About a quarter of high school graduates leave Slovakia to study abroad, primarily in the Czech Republic. The fathers and mentors should concentrate on the roots of the problems and on developing educational methodologies attracting them not to leave or to return.

In 2012, the Slovak Accreditation Commission was expelled from ENQA - European Association for Quality Assurance in Higher Education. The fathers should redesign the university philosophy and change its priorities to make it compatible with the ENQA principles. The politicians should ask for implementing these measures in legislation and returning Slovakia to the European mainstream.

- **Changing the current practices:** No Slovak university belongs to 500 top universities in the ARWU ranking [27]. The university strategy should focus on employing only the mentors, couches and gurus capable of demonstrating internationally recognized outcomes and get rid of those who produce average and low-quality ones.

To a high degree, the lagging behind is caused by almost-zero academic mobility. Most educators and researchers stay at the same department for all their lives. Their everlasting stability reduces their readiness to get adapted to ever-changing conditions and look over their local horizons. Again, the politicians should concentrate on measures leading to more intensive mobility and getting "fresh blood" from outside their institution.

- **Building universities of the future:** Slovak (as well as most CEE) universities prioritize the so-called Humboldt model. It puts research at the top, followed by education, and neglects the third university role – service to community. Šima and Pabian [28] proved that the Humboldt model was never implemented to its full extent because it fits adequately to the doctoral study only. At Bachelor and Master levels, the university is more oriented towards "mass production" of professionals requested by business and industry. With the increasing role of research and development in product and services innovation, the collaboration between industry and universities

is intensified and leads to a new model – the entrepreneurial university [29]. This concept is factually unknown in Slovakia and exceptional in CEE. Some acts included in the Slovak legislation contradict it directly or indirectly. Logically, most universities do not build visions which would respect it.

Generally, CEE universities work insufficiently on their development towards the most contemporary university models and their sustainability. They are in need of enlightened leaders – especially Fathers and Politicians. Without their deep professional involvement, there will hardly be any progress because there is no one ready to set up visions and specify milestones on the road to them. Some of the hindrances causing their absence are caused by the legislation. For example, the rectors and deans are elected for four years and they cannot occupy their posts for more than two consecutive terms. Due to that, many of them do not see a reason to professionalize their management-oriented knowledge and leadership skills. Without relevant modifications in legislation, the progress is hindered.

Nevertheless, a considerable portion of guilt falls on the Slovak academic community. It does not do intentional harm to universities; its guilt lies in something else. The academic community is:

- **Conservative:** It refuses all changes that might modernize the university environment. Recently, the eight biggest universities have signed a document in which they rejected the proposal Learning Slovakia and the amendment to the University Act changing the legal status of the Slovak Accreditation Commission [30]. Both documents want to open the door to the international academic community and local stakeholders.
- **Passive:** Its passivity is an indirect consequence of the conservativism. To avoid any changes, the academicians do not come up with initiatives that would lead to innovations and might affect status quo. For example, the above-mentioned refusal was not accompanied by a proposal what else to do for modernizing the tertiary education system.

7 Conclusions

Thank Slovakia belongs to a small group of countries whose quality control mechanism is not compatible with European standards. To comply with the Environmental, Social and Corporate Governance (ESG) 2015 standards [31], the university should build its own scaffolding, thus supporting the design, development and critical control of its own activities based on Kess' typology. The shift should primarily lead to lessening the accent on explicit knowledge, to higher recognition of the tacit one and to facilitating the collaboration among the knowledge workers of all types.

Unfortunately, the author is quite pessimistic about Slovak universities implementing some of the aforementioned changes in the foreseeable future. Many of them are divided into smaller alliances by particular interests or groups of departments and faculties. In addition, to some extent, the current ill-fated state-of-the-art is caused by the low budget assigned to public universities and education in general [22]. Also, it is allocated for one year only. It limits any long-term planning. Therefore, the role of fathers and politicians is very rare or non-existent.

A substantial number of Rectors and Deans are, therefore, convinced that the excellence in research and education will automatically appear with greater funds [30] and refuse to make any changes prior to the substantial budget increase. Their fear is not complete fiction. The lack

of money leads to tensions among university faculty. There is a real danger that releasing these tensions might lead to open wars between the various parties or even to the total collapse of the institution. At the same time, they neglect the fact that an increase in the university budget will not automatically lead to better management and that a university budget (high or low) does not correspondingly translate to better fiscal and operational management.

The proposed Learning Slovakia program [22] presumes that the organizational structure of a university would be in its hands, and with this, the university could modify it as desired. Although the universities are aware that their current strongly hierarchical structure is outdated, they are afraid of changing it. However, their organizational structure cannot change until they have got sufficient numbers and proportions of knowledge workers in all six directions. To respond to the above described challenges, the roles of Politicians, Fathers and Mentors in the university's sustainable development should be strengthened. To prepare the future changes, the management should pay its attention to their education. This preparatory stage could also reduce the current conservativism and passivity.

It is obvious that the organizational culture of Slovak universities, as well as others in this group of nations in the CEE, must change significantly. In the previous years, their growth was primarily extensive [32]. This way does not offer further potential due to the declining demographic curve [22]. Incoming changes must address the quality of tertiary education, in particular its diversity. However, to change is to upset the status quo, but as Peter Drucker said: "Not all change is improvement, but without change there is no improvement". He further said: "Change is a gift – it is an opportunity to start again" [33]. Thus, it is change that is needed to bring Slovakia and other CEE universities in line with Universities in the 21st century.

Acknowledgments

The author expresses his gratitude to Prof. Arthur Rubens for his consultation and support during preparation of this paper.

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Quality Management System in Service Activities of the Automotive Industry

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Abstract: The author deals with analysis of providing services by means of service points for various car makes. The service points for various car makes have to comply with the criteria of the ISO 9001:2008 standard and with special requests of producers of each car make. This should lead to higher competitiveness among different service points of different car makes. As a result, the customer should be satisfied with the provided services. The Quality Management System has been implemented in dealers of SEAT cars since 2004.

All SEAT Contract Partners – that is SEAT Service Outlets with a Service Partner contract or with a Service Center contract – are obliged to introduce and maintain the SEAT Service Quality Management System (SSQMS) [2]. SSQMS focuses on achieving the pre-eminent Service objectives: "*More customer satisfaction - Greater market share - Better business results"!*

Keywords: Quality Management System, automotive, service, SEAT.

1 Introduction

All SEAT Contracts Partners have to use the International SSQMS Evaluation Guide. The checklist is the main element of the SSQMS:
1) SEAT requirements (Contract and Standards). In this group there are:

i Mandatory criteria for Service Center and Service Partner.

ii. Mandatory criteria for Service Center but complementary criteria for Service Partner.

iii. Complementary criteria for Service Center and Service Partner.

iv. Mandatory criteria for dealers (in a separate file).

2) ISO 9001:2008 requirements.

Defining actions for not completely fulfilled criteria

Non-conformities:

For criteria written in the bold font with 0 points.
Recommendations:

For criteria written in the bold font with half points, non-bold criteria either with half or with 0 points, and any other improvement/recommendation the auditor considers.

Requirements for SEAT Service Contracts

SEAT Service Center:

The Service Center has to reach more than 0 points of Service Center standards (i, ii). Additionally, the sum of all points has to reach a minimum of 1200 points (sum of criteria i, ii, iii).

SEAT Service Partner:

Service Partners have to reach more than 0 points of the Service Partner standards (i). Additionally, the sum of all points has to reach a minimum of 1100 points (sum of the criteria i, ii, iii).

All current SEAT Service Center / Partners or future applicants for a SEAT Service contract must approve the first and following yearly audits of the SSQMS [3].

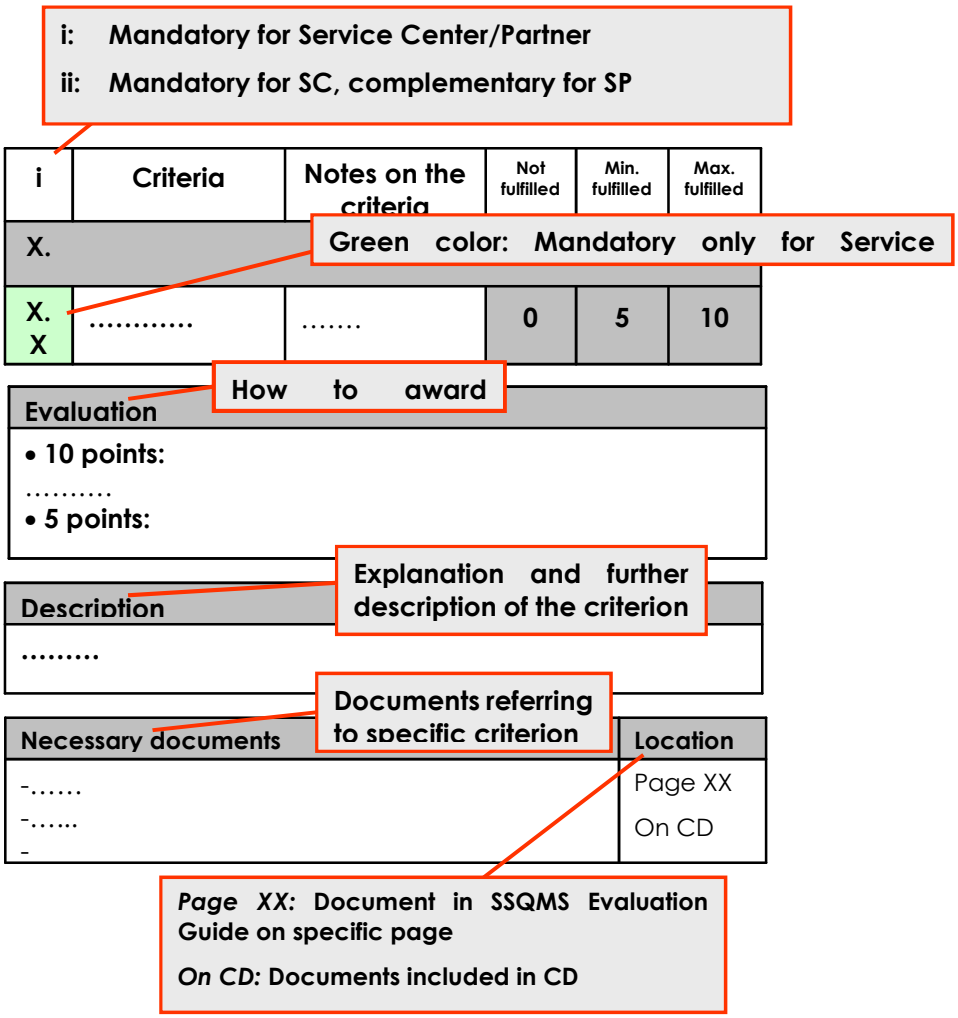
2 International SSQMS Evaluation Guide

The SSQMS Evaluation Guide details the SSQMS Standards by

- Explaining each standard (*Evaluation*)
- Giving further explanation for each standard (*Description*)
- Referring to specific master sheets in the Guide and other data sources (Besides the requirements defined by SEAT S.A., the country's specific requirements need to be taken in consideration).

The following overview explains how to understand the SSQMS Evaluation Guide:

- **Tab.1** *Table of SSQMS Evaluation* [3]



Content of SSQMS Evaluation Guide SSQMS:

0. Introduction
1. Facilities
2. Management, Organization, Processes and Personnel
3. Customer Contact Area
4. Spare Parts
5. Workshop [3]

3 Quality Management System in service of SEAT partners

Activities to improve the quality have to be visible. The management are responsible for quality, e.g. measures to improve service quality, informing employees about quality, informing

about the importance of fulfilling legal requirements, frequent talks with service and parts departments.

General requirements

The organization shall establish, document, implement and maintain a quality management system and continually improve its effectiveness in accordance with the requirements of this International Standard.

The organization shall

a) identify the processes needed for the quality management system and their application throughout the organization,

b) determine the sequence and interaction of these processes,

c) determine criteria and methods needed to ensure that both the operation and control of these processes are effective,

d) ensure the availability of resources and information necessary to support the operation and monitoring of these processes,

e) monitor, measure and analyze these processes, and

f) implement actions necessary to achieve the planned results and continual improvement of these processes.

These processes shall be managed by the organization in accordance with the requirements of this International Standard. Where an organization chooses to outsource any process that affects product conformity with requirements, the organization shall ensure control over such processes. Control of such outsourced processes shall be identified within the quality management system.

Processes needed for the quality management system referred to above should include processes for management activities, provision of resources, product realization and measurement [1].

Management review

The top management shall review the organization's quality management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness. This review shall include assessing opportunities for improvement and the need for changes to the quality management system, including the quality policy and quality objectives. Records from management reviews shall be maintained.

Review input and review output

The input into the management review shall include information on

a) results of audits,

b) customer feedback,

c) process performance and product conformity,

d) status of preventive and corrective actions,

e) follow-up actions from previous management reviews,

f) changes that could affect the quality management system, and

g) recommendations for improvement.

The output from the management review shall include any decisions and actions related to
a) improvement of the effectiveness of the quality management system and its processes,

b) improvement of products related to customer requirements, and

c) resource needs.

The Self Assessment Audits will produce an action plan, which should be reviewed and implemented by the Dealership.

Internal audit

The organization shall conduct internal audits at planned intervals to determine whether the quality management system

a) conforms to the planned arrangements, to the requirements of this International Standard and to the quality management system requirements established by the organization, and

b) is effectively implemented and maintained.

An audit program shall be planned, taking into consideration the status and importance of the processes and areas to be audited, as well as the results of previous audits. The audit criteria, scope, frequency and methods shall be defined. Selection of auditors and conduct of audits shall ensure objectivity and impartiality of the audit process. Auditors shall not audit their own work.

The responsibilities and requirements for planning and conducting audits and for reporting results and maintaining records shall be defined in a documented procedure.

The management responsible for the area being audited shall ensure that actions are taken without undue delay to eliminate detected nonconformities and their causes. Follow-up activities shall include verification of the actions taken and reporting of verification results [3].

Continual improvement

The organization shall continually improve the effectiveness of the quality management system through the use of quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review [1].

4 Conclusions

The experience of audit indicates that the Seat Service Quality Management System is beneficial only if:

a) practical – tailor-made and suitable for business managers to achieve the intended results - all activities are facilitated; all materials and information can be found immediately; each employee knows what to do and how to do it; substitution and competencies are set up clearly;
b) economic – the ultimate aim of introducing a system of quality management in a business is to achieve a positive profit – to reduce costs, increase sales, and increase profitability;
c) documented – processed quality policy, quality objectives, quality manual, card processes, documented procedures, records - each action is recorded and described, signed by the responsible person doing the actual performance;

d) continuous improvement – improvement of all activities in the company can respond to the ever-changing needs and customer requirements - continuous collection of views of customers regarding their satisfaction and ideas for process improvement [4].

The Quality Management System by SSQMS was instituted in the Slovak Republic in 2004 in all SEAT service partners. The results came at the end of 2006, when SEAT Slovak services received the BEST IACS – the prize of the world customers' satisfaction. This prize is awarded every year. At the same time, SEAT grew by more than 20% according to the official registration of SEAT cars in the Slovak Republic [2].

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Statistical Process Control Education using Distance Learning

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Abstract: The paper describes the experience and system of work when applying the most demanding subject in Moodle. The course *Statistical Methods of Quality Control* is intended for students of the daily form studying by the distance method. Topics like SPC, seven base tools of quality management, and others master students using sophisticated tools of computer support. These are, for example, a webinar or remote access to the PALSTAT CAQ information system server.

Keywords: SPC - Statistical Process Control, LMS – Learning Management System, webinar.

JEL Classification: I23, I24

1 Introduction

This Innovative teachers can not imagine a teaching process without modern didactic tools. But some teachers are fighting new things and are opposed to using them. I belong to the first group and try to use modern didactic tools in every subject I teach.

2 Information about the course

The course MQ 501S Statistical Methods of Quality Control (the SMQC) thematically covers the topics of Quality Management: Seven basic tools of quality control (7 QC Tools), SPC - Statistical Process Control and others. The seven QC tools include:

1. Cause-and-effect diagram (Ishikawa or fishbone chart);
2. Check sheet (also checklist);
3. Control charts (is also related with SPC);
4. Histogram;
5. Pareto chart;
6. Scatter diagram;
7. Flow chart.

SPC is method of measuring and controlling quality by monitoring the manufacturing process.

Objective of the course in terms of learning outcomes and competences The aim of the subject is to acquire knowledge and skills for using statistical methods in full respect of quality standards requirements in accordance with quality management systems and TQM. TQM practices can be broadly classified as either “mechanistic” or “organic” where former is the systematic measurement and work controls to reduce variability [5].

After completing the course students will be able to effectively use methods SQC, SPC, emphasis will be placed on mastering the use of the methodology related modules IS PALSTAT CAQ in accordance with ISO 9001, ISO / TS 16949 and the requirements of the automotive industry IATF, AIAG, VDA.

The course content draws mainly from the literature: NENADÁL, J. et al. 2008. *Moderní manažment jakosti : Principy, postupy, metody*. Praha : Management Press, HRNČIAROVÁ, Ľ., TEREK, M. 2004. *Štatistické riadenie kvality*. Bratislava : IURA Edition and ISO 7870-2:2013. *Control charts - Part 2: Shewhart control charts.* The Fig. 1 is part of the syllabus of the course *Statistical Methods of Quality Control.*

TÝŽDEŇ	***TÉMA A ZADANIA***
1 3.4.–9.4.	**Úvod do problematiky;** **Štatistické metódy a systémy manažérstva kvality;** *Úvodné zadanie (SIA); online aktivita 1. (fórum)*
2 10.4.–16.4.	**Jednoduché štatistické metódy v manažérstve kvality - 7 základných japonských nástrojov QC** (*7 QC Tools*)**;** *Zadanie č. 1*
3 17.4.–23.4.	**Štatistické riadenie kvality - SQC;** *Zadanie č. 2 (formou fóra)* **Termín pre vybavenie proktoringu a zaslanie informácie o proktorovi a mieste záverečnej skúšky vyučujúcemu (do 23. 4. 2017)**
4 24.4.–30.4.	**Štatistická regulácia procesu - SPC;** *Zadanie č. 3* *Zadanie projektu v PALSTAT CAQ (modul SPC)*
5 1.5.–7.5.	**Regulačné diagramy pri kontrole meraním;** ***Zadanie č. 4 (formou fóra)***
6 8.5.–14.5.	**Regulačné diagramy pri kontrole porovnávaním;**
7 15.5.–21.5.	**Ďalšie typy regulačných diagramov;** ***Zadanie č. 5***
8 22.5.–28.5.	**Spôsobilosť procesov, zariadení a meradiel, MSA;**
9 29.5.– 4.6.	**Štatistické preberanie;** *online aktivita 2. (fórum)*
10 5.6. – 11.6.	**Záverečná skúška** **v Trenčíne - Pia 9. 6. 2017, v Bratislave - Po 12. 6. 2017** *Odovzdávanie projektu na UPLOADER (13. 6. 2017)*

Fig. 1 *Syllabus of the course Statistical Methods of Quality Control*

The target group of the e-course is represented by students of Quality Management - Specialization in Business Management Studies. Students are studying this course daily by using distance method. Distance learning - learning without being in regular face-to-face contact with a teacher in the classroom [1]. The evaluate of students is based on the assignments (Tab. 1).

Tab. 1 *Evaluation of course Statistical Methods of Quality Control*

Assignments	Percentage of Final Grade
Participation (practical assignments and online activity)	40 %
SPC project	30 %
Final Examination (open book PC test in Moodle)	30 %
TOTAL	100 %

Computer aided of this course include MS EXCEL, MINITAB®17, PALSTAT CAQ®, use MS SQL server and RDC (*Remote Desktop Connection*).

3 Organization of learning activities

The course MQ 501s is taught by a distance method and has standard e-course support in the open source LMS in platform Moodle. In Fig. 2 is the entrance to the education environment of the VŠM in Trenčín.

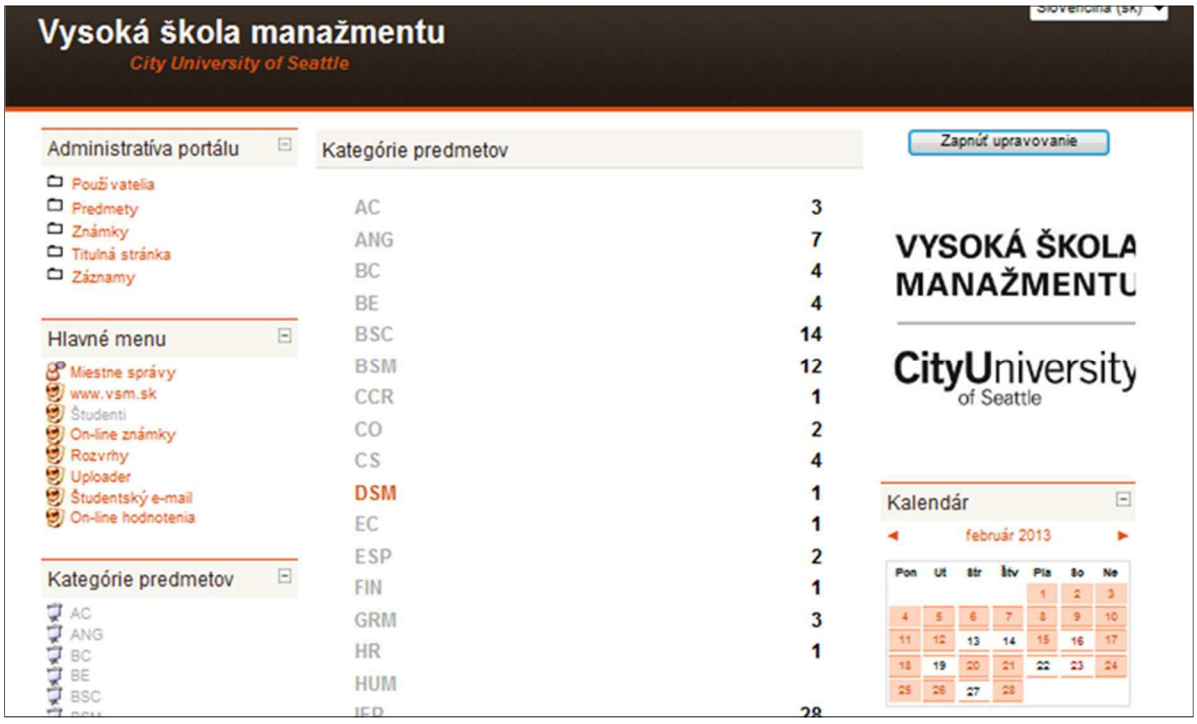

Fig. 2 *LMS Entry Gate and distribution of e-courses to categories*

In the VŠM is created a working position "Online Center Administrator" to manage e-courses. All of the e-courses for all subjects of the VŠM are regularly updated, after the end of the quarter, they are backed up and stored in the archive. There is a certain amount of time available to the teacher. Subsequently, e-courses go to "Šrotoviska", where they will be erased after a certain time. Subjects for the next trimester are recovered from the backup in the "Preparation". This system provides the maintenance, reusability and sustainability of the online education system of the VŠM, which is very robust (it contains on average 150 different e-courses per trimester).

The E-ccourse is divided into 10 blocks, each for one quarter a week. In this e-course, the scope of the subject matter prescribed in the syllabus of the subject is completely covered. This is especially because it requires electronic support for students of the distance method. Educational goals (learning objectives) are summarized in syllables, divided and then inserted into individual learning blocks in the sense of Bloom Taxonomy [1].

Each topic has a tutorial in various forms. In the practical part, most of the examples are processed in MS Excel, which contain a clear commentary and formulas for a better understanding of the solution's results. In the Fig. 3 is the introduction to the e-course MQ 502s.

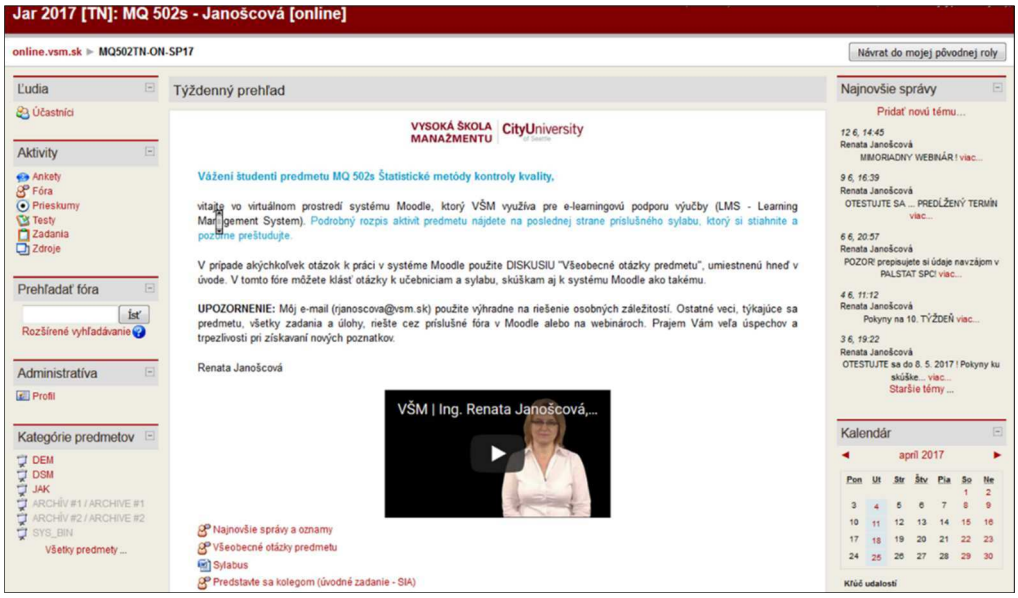

Fig. 3 *Introduction to MQ 502s Statistical Methods of Quality Control*

The calendar alerts students to different dates of activities (assignments, forum submissions, tests, etc.) and greatly helps organize the study, which is especially important when using the distance method. Regular contact of the teacher with students studying distance is provided by the Webinar. The webinar is available every week for one to two hours. Students can communicate with a teacher as a classical consultation but online. They can also share their files and present problem and other colleagues in the team.

A great help for students of both methods is the recordings of past webinars, placed in the "Online Support" block. In the Fig. 4 is the webinar in *Blackboard Collaborate* (BC) platform.

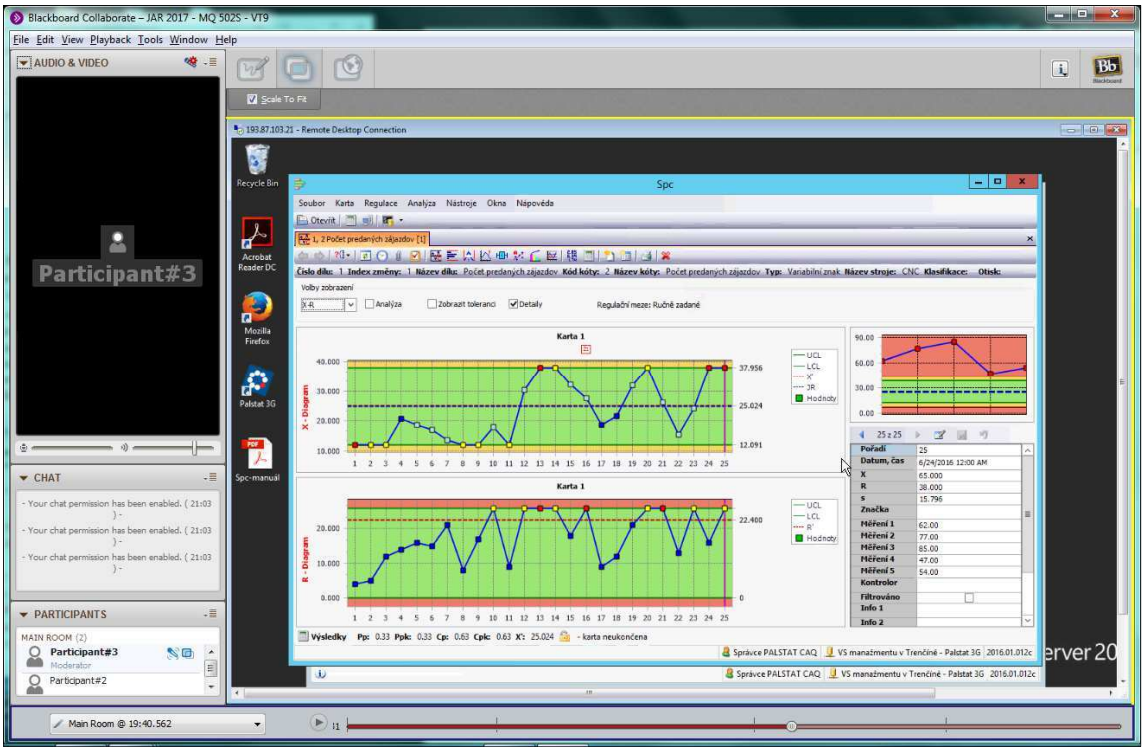

Fig. 4 *The webinar in Blackboard Collaborate*

4 Course processing

The structure of the e-course is in line with the standardized "template" of the VŠM. The minimum content structure of which must be complied with by all teachers (so far only in the distance study). There is a minimum number of media sources (custom videos, online support files, audios, video clips, hyperlinks, etc.). Educational goals (learning objectives) are summarized in syllables, divided and then inserted into individual learning blocks in the sense of Bloom Taxonomy.

Each topic has a tutorial in various forms. In the practical part, most of the examples from the obligatory literature are processed in MS Excel, which contain a clear commentary and formulas for better understanding.

5 Activation of students

The E-course combines elements of synchronous and asynchronous communication. Synchrone is ensured by the possibility of gradual visualization of prepared content in accordance with time schedule and style, deadlines for fulfilling different tasks and the term of regular webinars (online consultation) for the distribution of students.

Students use several well-known e-learning tools to share electronic materials (lectures, examples, case studies, assignment tasks), electronic tests with random selection of different types of questions (including self-assessment tests), surveys, teamwork. Distance students use, in addition to these tools, constructive discussions in forums and webinars, which are an interface between the classroom and the e-course (students meet with teachers at the same time

from different places). Continuous assessment managed by the online system's direct feed-back possibly increased the efficiency of the continuous assessment further [6].

Some tools share both "day" and "online" students, even collaborating on some activities and enriching each other. In e-course is a balanced number of activities in which students work in a team (for example, structured forums) and activities that are focused on the implementation of individual skills (practical assignment in MS Excel, etc.). In the Fig. 5 is the illustration of structure of e-course MQ 502s.

Fig. 5 *Structure of e-course MQ 502s*

6 Conclusions

The aim of improving the quality of higher education is to bring the forms of study closer to the content. Based on my own experience, I know it's possible ...

But only:

- with motivated teachers,
- with technically competent teachers using electronic tools appropriate to a particular subject,
- on the LMS platform maintained (LMS Administrator Function),
- but especially with the necessary institutional support of top management.

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Industry 4.0 and entrepreneurship of people with disabilities

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Abstract: With technical evolution work processes are changing. Big enterprises have often the advantage of having well developed organizational structures to adapt on possibilities of Industry 4.0 and even to influence the further technical development of global working culture. Only if organizational structures and technical instruments harmonize an improvement of work processes can be realized. The discussion focusses on this challenge and gives examples.

Keywords: Industry 4.0, entrepreneurship, organization, disabilities.

1 The key elements of industry 4.0

The industry 4.0 is a word creation based on (industry 1.0), mass production (industry 2.0) and automation (industry 3.0). Industry 4.0 describes the digital networking of all people, machines, processes and systems involved in the production and value chain, and also as a fourth industrial revolution. (DUDEN WIRTSCHAFT 2016, [translated by the author, 25.09.17]).

Following the industry 4.0 paradigm, all objects of the factory world are equipped with integrated computing power and communication capability. This is by no means only about machine-to-machine (M2M) communication, but will also have far-reaching implications for the interaction between man and technology. Against the background of technological progress, it is to be assumed that both the task and the demand spectrum of the human being in the factory will change. As machines and workpieces become increasingly autonomous, complex production scenarios, such as the custom-made production of individual items, can also be managed without human intervention. In this case, the classic, location-based workplace (for example a control room or office) will increasingly lose importance from the face-to-face networking and mobile real-time information. The decision-making and monitoring processes can also be carried out directly from the place of action and be managed from a distance - and for a variety of different production plants. Thus, the assumption goes that the individual employee will in the future shoulder a larger area of activity and responsibility - also in terms of space. (Gorecky 2014 [translated by the author, 25.09.17])

From automation to networking, that’s an important aspect of Industrie 4.0. A large number of technical concepts and applications are already being marketed under the term Industrie 4.0. Characteristic elements for this were Prof. Dr. Five central fields (ESCH 2015 [translated by the author, 25.09.17]):

- The automation, by which increasingly data-driven decisions are made on the basis of big-data analyzes.
- The standardization through which uniform communication standards and interface standards for data processing are created.

- The embedding of sensors as components of physical actors, which lead to a fusion of hardware and software.
- Digitization, with which information can be recorded and processed, thus enabling the creation of a digital image of the goods flow.
- The networking between man and machine as a central component along the value chain.

These developments represent an advantage for entrepreneurs but especially for the disadvantaged one because these new possibilities can compensate their deficits. Be it due to language, cultural or handicap nature. Therefore, it is important to analyze the requirements to introduce industry 4.0 in a successful way.

2 Organizational requirements for successful implementation of industry 4.0

The overall goal of this concept is to cope with growing flexibility requirements of the sales markets, an increasing individualization of the products, shorter product life cycles as well as a growing complexity of the process sequences and products. in other words, the existing technological and economic limitations of automation are to be pushed out of the increasing flexibility requirements. Theoretically inspired by Latour's Actor Network Theory, which suggests a broad equality between human and non-human actors, the role of an active actor is distinguished from the traditional perspective on technology as a passive object of technology. It is also spoken of "hybrid" systems in which the task and action relationship between technology and human beings always recurs in a specific way. Conceptually, this refers to the often-overlooked fact that automation does not only affect individual jobs, activities and the qualifications of individual persons, but also has consequences for the entire organizational and social network of a production system. On the other hand, this socio-technical system is again linked to higher-level strategic guidelines and is an element in the overall process of a value-added chain. If one follows the concept of the socio-technical system, the relevant dimensions of the change of production work in the context of autonomous production systems can be precisely specified here: a) the direct man-machine interaction and the immediately related qualification requirements, b) the task structures and the (C) the work organization as the work-sharing structuring of tasks and activities in a horizontal and hierarchical way, and thus the formation of cooperation and communication between the employees working in the system and out of the system. (HIRSCH-KREISEN 2014, [translated by the author, 25.09.17]).

That means, that enterprises need employees with technical knowledge, so that this aspect gets more and more important, so that deficits like physical handicaps or not enough cultural knowledge lose on meaning. This fact is also valid for the entrepreneurship of disadvantaged persons. For them industry 4.0 offers more possibilities to create their own business. On the other side the organizational requirements rise. Task structures and work organization must be defined clearly, so that the communication in the company and the acts of its employees based on technological systems keeps effective. To assure this two elements are important: Job descriptions for the staff are required, as well as an organizational guide, which, however, adapts to the business needs and has some flexibility in terms of changes. Because of technological developments and the rising global exchange enterprises needs to be prepared for quick changes and that is why founders must invest much time in organizational measures. Think on the rapid rising use of smartphones and the changing of communications in most

cultures because of this technology. The use of smartphones gains every day more on meaning in professional sectors. A mass of applications for smartphones gets developed every day and so, more possibilities get offered to entrepreneurs and founders. But without proper organizational structures the advantages of new technologies can´t be used in an effective way. It can even be argued that thanks to good organizational structures, the meaningfulness of the use of certain technologies can only be estimated.

The project enterability is a German project helping people with disabilities to become founders and to develop their entrepreneurship successful, because the changes to get a classic job are too low. It started on 2013 and has supported 300 founders till 2016. 2015 enterability has won the European enterprise award. Two phases are focused by enterability (http://enterability.de/ [25.09.17]):

- Before foundation
- After foundation

As said before, enterability concentrate on organizational precautions, so that it client's projects can be realized. That means they offer following services before foundation:

- Giving knowledge for founders (personality of founder, project idea and market analysis, marketing, time management and organization, accounting and administration, legal aspects, establishment formalities)
- Including the specificities of the disability of the founder in consulting of the project.

Services after foundation:

- Formal Processes: e.g. Commercial registration, tax registration, invoices, contracts and general terms and conditions
- Dealing with offices: Application for benefits from the Agency for Employment or the Integration Office
- Social security: health insurance, voluntary unemployment insurance, old-age provision, professional association
- Accounting: office organization, cash register and bank book, business analysis
- Controlling: Evaluation of the monthly balance sheets and the annual financial statements
- Financing: access to micro-credit and mediation of grants and loans
- Marketing and customer acquisition
- Networking: Industry- or topic-specific networking with other enterability founders
- Advice and assistance with technical work aids and with questions of "handicapped" work organization
- Health Prevention: dealing with mental and physical stress situations, questions of the work organization
- Crisis intervention and plan adjustment
- Ordered business task: help with the proper handling of the company and avoiding debt.

3 Examples

Use In the following sectors can be found ideas of entrepreneurships:

- Law and advice
- Technical services / traffic and transport
- Office services
- Leisure and culture
- Communication
- Wellness and fitness
- Real estate
- Education
- Social sector
- Textiles
- Manufacturing industry
- Sales

Founder of: Sweetstore

Degree of disability: 100 GdB

Since July 2013, Ali Lacin has been the owner of the sweetstore self-based sweets store. Right after his successful training as a wholesale buyer, he and his brother put his business idea into practice: they opened a wholesale trade with specialization in vegetarian sweets and those that did not contain any gelatin from the pig.

Ali and Osman Lacin sell not only special products, but also old-fashioned confectionery such as chocolate bars, nibbles, drinks, chewing gums and much more. In addition to the pick-up warehouse, the daily business also includes a delivery service for the Berlin / Brandenburg sales area. As of March 1, 2015, the young company is now starting with the online and ebay shop and can supply DHL with a strong logistics partner throughout Europe.

It proved to be a good start for the beginning that they had network-relevant network contacts from the outset through their father's professional activities.

Ali and Osman Lacin master the logistics and customer service with a high-lift truck and a clear task division so that Ali Lacin, who carries two leg prostheses, can meet his stress limit and even has time to go to practice four times a week. He is on the right track to qualify for the Paralympic Games 2016 in Rio.

4 Conclusions

Especially the last example shows that good organizational structures and combination with Industry 4.0 can support entrepreneurships in a new way, so that the last industrial revolution has led to more possibilities especially for people with disadvantages, so that industry 4.0 can be seen as a further aspect to better introduce elements of democracy.

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Opportunities and Challenges of Knowledge Management in Educational Institutions: Use of Social Networks

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Abstract: Success of an organization is increasingly determined by its ability to improve its performance through learning. Those organizations that do not know and passively wait until the consequences of change begin to cause problems do not have a chance to survive. At present, knowledge and work with it are at the forefront of the interest of experts in many areas. These include areas such as national and transnational policy, management at organizational level, computer science at the level of knowledge management as well as academic area at all levels. In our work, we try to focus on the challenges and opportunities that application of modern tools of knowledge management in educational institutions may bring.

Keywords: knowledge management, social networks, educational institution.

1 Introduction

The world has begun to rely more on knowledge after finding out that the economic functioning of the society has changed. First, there was a focus on how to make the most of the minimum of resources. Later, the focus was on the production of smart products. At present, modern organizations are focusing on cost-effective solutions and relationships with clients for their successful marketing. Emphasis on knowledge management is a natural consequence of economic, industrial, and cultural development. Many former developing countries can compete with developed countries in technology, software development, advanced product design, and more. Competitiveness in offering the best products and services based on relevant knowledge has become truly international. Companies that have applied knowledge management for some time can boast tangible and intangible benefits. The benefits of applying knowledge management are also visible in their leading position within various sectors of the economy.

At present, we are all bombarded by a huge amount of information of every kind on every side. This trend gives scope for the use of knowledge management tools in virtually all areas of human effort. Educational institutions, whose mission is to collect and manage information and share knowledge with students and the public, should be the leaders in the use of knowledge systems.

Educational institutions are aware of the need to manage their growing academic and intellectual resources by more effective methods and practices, especially those that are produced electronically and can easily be lost or devalued [1]. There is an increasing need to retain knowledge such as procedural practices, individual and collective presentations, online materials, or ongoing research, whether in the form of tacit or as explicit knowledge. Knowledge management can help achieve these institutions' resource conservation goals, understanding their knowledge, sharing knowledge within the academic community, and understanding processes to streamline administrative and professional activities.

Preparing successful graduates for the needs of a knowledge-based economy requires a learning environment that promotes creativity and commitment to lifelong learning. Educational institutions are trying to educate graduates capable of competing in the knowledge society. This effort forces these institutions to function in a state of continuous progress, analysis and response to external opportunities and threats arising from knowledge creation and sharing [2].

2 KM Strategies in Educational Institutions

McCarty's [1] research focused on the application of the knowledge management principles used in the corporate economy as well as in educational institutions. As for the issue of growing academic and intellectual resources in the field of education, research revealed a mix of ways to solve this problem. One of them was application of a knowledge system aimed at protecting, organizing and indexing formal knowledge, which can be kept in the form of documents and databases. Another solution was to create a knowledge-based community. This strategy involved the use of groupware for formal and informal communication, which became the source of lessons learned or expert database. The results indicate that not all intellectual resources have the same need for retention. It is, therefore, necessary to decide what is necessary to preserve. These decisions were left to individual academic departments.

Another area of research was finding out how a successful process of building knowledge increases the activity of academic staff and students. The outcomes show that those institutions which use knowledge management are doing better although there are still problems with the formation of knowledge-making communities. The concept of knowledge management has not led to consistency in defining this term or consistency in how it is applied in different departments. The communication networks of knowledge workers and their exposure to various interest communities have led to broad sharing of experience and professional skills.

The third area of research was the role of the technical system in sharing knowledge. It was found that the possibilities of storage and retention of knowledge generated by technologies are indispensable for the interconnection of essential competencies and the maintenance of communities. Knowledge systems have linked knowledge workers and supported existing and emerging communities. The technical infrastructure has been used to acquire tacit knowledge and transform it into explicit knowledge. These were expert databases, repositories, and online blogs as collaborative spaces. The key benefit of the knowledge system was better access to information in one place [1].

The findings of the Knowledge Management application research show that concepts of learning, sharing and knowledge transfer are the cornerstones of educational institutions, and processes and technologies such as knowledge systems can be powerful means of linking communities within the institution.

The results of the research on the knowledge management implementation in educational institutions led to provision of several priorities for a particular organization. First of all, it is creating a favorable environment for knowledge acquisition and creation (so-called Ba) [3]. It is about gathering information about the latest research results in a particular field of study, the processes and practices used in other institutions, and the possibilities of working with other institutions in the field. In order to create a favorable environment for knowledge creation, it is necessary to organize regular meetings, seminars, working groups or conferences.

It is necessary to create conditions for both physical and online interaction between members of the academic staff and students to achieve constant sharing of the best practices. The purpose of creating and sharing of knowledge is its use and application. It will, of course, vary depending on whether it is used by students, administrators or members of the teaching staff.

Two universities with an identical number of teachers, study programs, spending, and number of students can vary considerably based on ratings by official institutions as well as the public. The difference often lies in the intangible added value created by the effective knowledge management. It is applied through web based portals that are used for teamwork, sharing the best practice information, as well as anywhere and anytime available learning platform.

N. Aharony [4] focused his research on the use of a wiki as a part of knowledge management training to promote discussion in the process of creating and sharing knowledge. A wiki was used as a means of presenting information and projects, as a means of discussion between the teacher and the student, as well as a knowledge repository. The findings showed that the discussion section of the wiki included collaborative, content-related comments as well as social comments. The major part, however, focused on the content related comments and reflected the use of deep knowledge. Yet, this way of learning requires the instructor and students to participate in, encourage and maintain discussion.

The knowledge portal Info-Ca-Sh created by a team of staff at the Government College of Engineering in Salem, India [5], is also an example of a platform for sharing knowledge among teachers and students. This portal is aimed at improving the sharing and codification of knowledge and analysis of social networks of educational institutions.

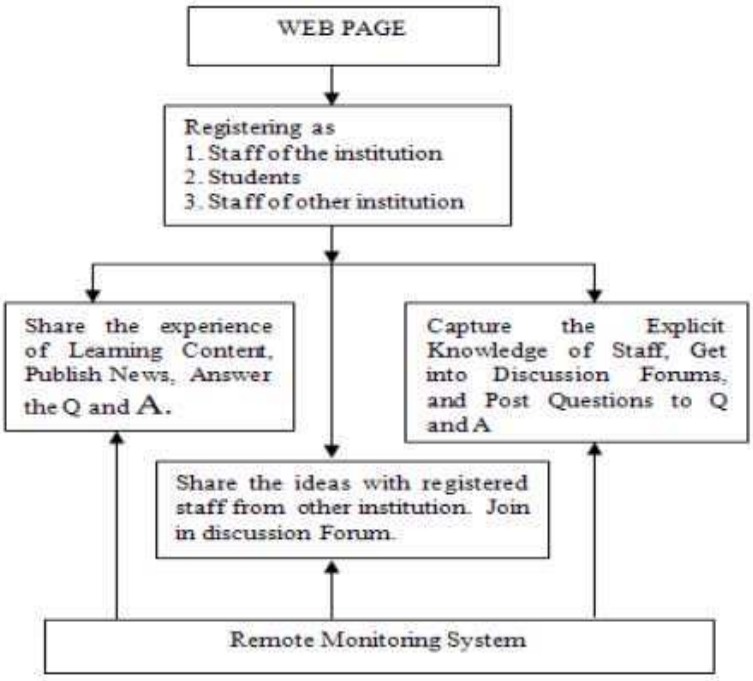

Fig. 1 *Entity Relationship Diagram of Info-Ca-sh [5]*

Figure 1 shows the entity relationship of the Info-Ca-Sh knowledge portal. The portal has a data repository of academic staff and students of the institution. It also involves sharing and capturing tacit knowledge through blogging. Of course, the portal provides space for discussion, too. It serves as a base for a social network consisting of faculty and students, creating nodes representing some type of interdependency based on similar interests, beliefs, knowledge or prestige.

3 Social Networks as a Learning Tool

According to Xiang Liu [6] from the Marymount University in the US, 65% of university students prefer the Internet as a source of knowledge and 20% turn to teachers or classmates. Only the remaining 15% use a library for this purpose. The author considers Web 2.0 tools, along with social networking tools, to be a great opportunity and a way to bring students to a "knowledge country".

Anam Ali's [7] study done at a medical school in the UK focused on usage of Facebook as a learning tool. Students used their profiles, groups, and pages to post questions and discuss work. The results showed evidence of collaborative learning occurring on Facebook through peer teaching and sharing of learning experience. Facebook also assisted students in creating and maintaining connections with peer students, keeping them updated on social events and societies. In addition, it helped them in transmission and sharing of academic resources in various media forms, such as documents, videos, Power Point presentations, and websites. The study suggests that Facebook can be used as a complementary educational platform that allows each learner to create a personalized online learning space.

A recent survey in Slovakia showed that up to 93% of students and 75% of intellectuals use social networks and the most preferred platform is Facebook, which is used by 49% of the Slovak population over 14 years of age [8]

All of the above mentioned examples support the precondition that current students are digital natives preferring online resources and platforms as their primary source of information and knowledge sharing. That can be designated as the most important aspect of knowledge management, since the majority of KM initiatives depend upon it.

Current trends in education reflect an increase in popularity of online learning all around the globe. This mode of study has a great potential of contributing to worldwide mobility, lifelong learning and equal chances in international education [9]. It provides several advantages to students compared to the traditional classroom mode. It is more accessible since students are less bound by time and location. It provides a higher degree of flexibility as students are not limited by fixed schedules and can continue in their personal activities and obligations. Finally, distance learning is more affordable since it is often less expensive than the classroom mode. This way, it brings a learning opportunity to those who otherwise could not afford studying for a degree.

Increasing use of both distance learning and social networking platforms leads to a logical conclusion of merging the two in order to improve online teaching and learning. Social networks provide space for sharing information among students, as they are personal or learning-centered and help create intimacy among online students, as they have the ability to connect and build community in a socially and educationally constructed network.

On the contrary, course management systems like Moodle or Blackboard are narrowly focused and miss the personal aspect as well as the capacity provided by social networks. The use of traditional online learning modules is rather a question and answer type of mode than interaction. Social networks are user-centered rather than class-centered and increase student engagement. They can actively encourage online community building, extending learning beyond the boundaries of the classroom [10]. Figure 2 shows comparison of a traditional course management system (CMS) and a typical social networking site (SNS).

Tools	SNS	Traditional CMS
Forum	X	X
Blog	X	X
Media Sharing	X	
Messaging	X	X
Wiki		
RSS	X	
Chat	X	X
Calendar	X	X
Tagging	X	
Own Brand & Visual Design	X	
Realtime Activity Stream	X	
Groups	X	
Friends	X	
Profile Pages	X	
File sharing		X

Fig. 2 *Comparison of a social network site and a course management system [10]*

When used correctly, social networks can get students to practice lower level thinking at home and prepare them for higher level thinking in the classroom [11]. The opportunities provided by the use of social networks as an online learning platform can be defined as follows:

Increasing student collaboration – social media networks serve as an easy contact link with other students to discuss school projects and assignments. They can easily ask peers as well as instructors for help, and the whole class can have access to various feedback.

- Encouraging participation – shy students who do not participate in class can see the social network as a convenient platform for expressing their ideas. Current students are raised by the internet and social networks, which are a natural way for them to interact. It helps them build self-confidence and encourages them to participate.
- Easy resource sharing – websites, videos, tutorials are easily shared by a click of a button.
- Preparing students for future employment – students can easily make contact with employers and other job seekers. With LinkedIn, students can establish a professional web presence or post a resume [12].

Of course, there are also several threats coming out of the social networks used in education:

- Distracting from classroom participation – students can start using the social networks for their personal purposes and not pay attention to class content.
- Posting inapropriate content – bad language or images can be harmful to the institution's reputation as well as to students.
- Cyberbullying – malicious behavior, harassing students by hurtful messages.
- Social networks divert from face-to-face interaction – for many individuals it is easier to interact online; students lose real-life social skills [12].

4 Conclusion

The way in which a knowledge management strategy is implemented in a sustainable manner in an educational organization is not simple, and potential solutions need a broad range of strategies and strong and visionary leadership in institutionalization of such a practice. One of the efficient strategies seems to be the use of social networks in education. There are some threats to be considered that require continuous review of practice. Social network guidelines and policies are useful tools in supporting their use in schools and colleges, but these should not hinder creativity. Social networks provide real opportunities for innovative and engaging practice with authenticity and informality, something that represents effective educational features.

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Testing the Wisdom of Crowds in Students' Group Work

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Abstract: In his book, "The Wisdom of Crowds", James Surowiecki argues that a group becomes "smart" and makes better decision than an individual if the group satisfies the four conditions-diversity of opinion, independence, decentralization and aggregation. This paper intends to investigate whether groups that have higher diversity of opinion, independence, decentralization and aggregation perform better than the groups that don't. Ideally, the groups should perform better when they satisfy the four conditions better. One set of groups followed The Wisdom of Crowds hypothesis while another set of groups, working on a different task, did not. Both sets of groups, however, performed better when they had higher diversity of opinion.

Keywords: wisdom of crowds, knowledge management, diversity of opinion, independence, decentralization, aggregation.

1 Introduction

While visiting a country fair in Plymouth, England, a scientist named Francis Galton came across a weight judging competition where participants were asked to guess the weight of an ox. All the guesses were then combined to calculate the average guess of the participating crowd. He discovered that the crowd's guess (1197 lbs) was surprisingly close to the actual weight (1198 lbs). This estimate of the crowd was closer to the actual weight than any individual guesses [1]. In his book, The Wisdom of Crowds, James Surowiecki examines this behaviour of groups. He studies the collective wisdom of crowds and the conditions necessary to utilize this collective wisdom. Surowiecki argues that under the right circumstances, groups are remarkably intelligent and often smarter than the smartest people in them. According to him, there are four conditions that characterise the wise crowd: diversity of opinion, independence, decentralization and aggregation [1]. This study intended to test whether a group fulfilling these conditions would actually perform better than a group that does not.

This study was conducted during the "Innoweek" event at the School of Business and Information Technology at the Oulu University of Applied Sciences. For this annual event, students are divided into groups and these groups are challenged to come up with a solution to a real-life problem provided by external commissioners. The questionnaire was distributed on the last day of this week-long event and asked them whether their group fulfilled the four conditions as stated by Surowiecki.

The research was used to rank the groups based on the extent to which each group satisfied the four conditions of Wisdom of Crowds. In other words, the research ranked the teams based on their smartness. This ranking was compared with the final results of Innoweek to check whether the smartest groups actually performed better at Innoweek.

2 Wisdom of Crowds

Aristotle, a 4th century BC Greek philosopher, is known as the first person to discuss collective wisdom in his book Politics.

> *For the many, of whom each individual is but an ordinary person, when they meet together may very likely be better than the few good, if regarded not individually but collectively, just as a feast to which many contribute is better than a dinner provided out of a single purse. [2]*

Apart from the Francis Galton experiment, Surowiecki uses another example of the Google PageRank algorithm to further explain how Google uses the concept of collective wisdom to return the best search result at lightning speed. The algorithm largely depends on aggregating the links to one website from another, where each link is considered as a vote. Using these and more case examples, Surowiecki argues that a group becomes "smart" and makes a better decision than an individual, provided that the group satisfies the four conditions - diversity of opinion, independence, decentralization and aggregation [1]. He uses the example of prediction markets to exhibit the application of Wisdom of Crowds. In the prediction markets designed by the Iowa Electronic Markets (IEM), to predict the election results, people could trade futures contracts based on how they think a candidate will perform in an election. The IEM predictions were found to be accurate three-fourths of the time [1].

A group will not perform any different than an individual if group members have similar opinions. Surowiecki argues that each person should have some "private" information that is unique. Diversity of Opinion can be maintained by assembling a diverse group of people who possess varying degrees of knowledge and insight. The group should contain experts as well as people without knowledge in the field [1]. In large groups, diversity is obvious, but in smaller groups, it should be encouraged to avoid influence [1]. Diversity here should be understood as cognitive diversity, where people have various degrees of knowledge and insight [1].

Cohesion in homogeneous groups is more than in diverse groups. The group members' dependence on the group increases as they become more cohesive. This consequently insulates them from external influence and convinces them that the group's judgment must be right [1]. Diversity not only adds different perspectives to the group but also facilitates people to speak their minds [1]. Surowiecki gives an example of how the Kennedy administration failed during the Bay of Pigs Invasion due to a lack of opposing opinions as it was carried out under the guidance of the administration's few like-minded people [1].

Independence among group members is another condition for the group to be smart. The smartest groups consist of people with diverse opinions who are not influenced by others. Necessary measures should be taken to avoid groupthink. Groupthink occurs when a group makes faulty decisions because group pressures lead to deterioration of "mental efficiency,

reality testing, and moral judgment" [3]. The people in the group should be able to make their own minds and answer the questions independently and uninfluenced by groupthink.

According to Surowiecki, independence is important due to two reasons. First, it ensures that the human mistakes don't correlate. Second, independent individuals bring new data rather than the familiar old information [1].

Decentralization is the third condition for a group to be smart. Decentralization means that the group members belong to different backgrounds and are thus specialized in different areas and can draw on their local knowledge when making decisions. This contributes to diversity and independence [4]. According to Surowiecki, a group can become smarter by including people with local and specific knowledge. The chances of having a good solution increases when a person is closer to the context. Decentralization facilitates specialization, which in turn feeds decentralization. Specialization increases the productivity and efficiency along with widening the scope and fostering diversity of opinion and information gathering. Decentralization is of paramount importance to tacit knowledge. Tacit knowledge is knowledge that can't be easily summarized or conveyed to others because it is specific to a particular place or job or experience, but it is nonetheless tremendously valuable [5]. This definition sheds light on the assumption that the closer a person is to a problem, the more likely he or she is to have a good solution to it [1].

Aggregation is the method of converting various private judgements of individuals in a group into a collective output [1]. It explores whether people are making individual decisions or a collective one. Surowiecki identifies aggregation as the fourth condition for a group to be smart. He gives the example of the Linux Operating System, where a large number of coders working individually in a decentralized fashion contribute to improvement of the system. These contributions are then scrutinised by a small group of coders including the creator Linus Torvalds before being implemented, thus aggregating the work done by numerous autonomous individuals [1].

According to Lyon & Pacuit, mathematical aggregation methods like mean, median, mode, etc. can be used to aggregate the crowd's contribution. Group deliberation is another method of aggregation, which entails the crowd meeting to discuss the problem at hand before arriving at a collective judgement [6]. Prediction markets is another commonly used aggregation method to aggregate opinions, and it has been more popular lately [1]. Wikipedia articles and Facebook homepage can be viewed as examples of aggregation [7]. Facebook's algorithm gathers updates from the user's friends, aggregates them and only shows updates it deems important to the user.

3 Case Innoweek

Innoweek is an annual event organized by the School of Business and Information Technology at Oulu University of Applied Sciences (referred from now on as OUAS). Students from all the degree programs of the school participate in the event. They are awarded three credits for this project work course. The supervising teachers divide the students into groups. The teachers give special attention to maintaining the diversity by ensuring students from various degree programs and of various nationalities are chosen while forming groups. This idea of group work and dynamics of diversity in the group provide an opportune premise to investigate the proposition of the wisdom of crowd.

3.1 Innoweek

The objective of Innoweek as stated in the OUAS curriculum "*enables the students to act in the innovation process to develop activities of organizations or to identify new business opportunities. The goal is to develop innovation and team working skills.*" [8]. The students work in groups to tackle real life business problems. At the end of the week-long event, the groups present their ideas in front of a company representatives. In this year's event, two organizations (commissioners) challenged the students with their problems. The first commissioner was PrintoCent – a company that creates innovative products and business solutions based on printed electronics. They challenged the students to come up with proposals and marketing plans for their various products. The other commissioner, Student Union of Oulu University of Applied Sciences (referred from now as OSAKO), challenged the students to propose a plan to increase the voter turnout in the student union elections. The students had one week to work in their group to prepare a presentation that would be presented on the final day of the event.

Before the week of the event, interested students enrolled in the course. Students from all the degree programs at OUAS were eligible and a total of 61 students enrolled in the course. The supervising teachers for the course then assigned the students to two groups - PrintoCent (Group A/Task 1) and OSAKO (Group B/Task 2). The students from each task were then divided into smaller groups of four to five students. Eight groups participated in the first task while the second task had six. To maintain diversity while forming groups, the teachers chose students from different degree programs and included at least one foreign student in every group. On the first day of the event, the commissioners presented the challenge to their corresponding student groups. The students worked in their groups each day of the week to come up with the best solution. On the final day of the week, the groups presented their ideas to the commissioners.

3.2 Research Methodology

The objective of this research was to find out if the groups participating in Innoweek adhered to the theory of the wisdom of crowds as defined by James Surowiecki. The research intended to answer the following research questions:

1. Do the groups follow the wisdom of crowds?
2. What is the correlation between the four conditions - diversity of opinion, independence, decentralization and aggregation - and their performance? Do the groups that satisfy these four conditions better actually perform better in the tasks?
3. Is any of the four conditions more important than the others?

To answer these questions, a questionnaire was prepared and distributed to the students on the final day of Innoweek. The questionnaire was divided into four sections based on the four conditions of wisdom of crowds and each section contained three statements. The participants were asked to rate their opinions about the statements using a five-level Likert scale. Each level carried a score from 1 to 5. Every participant's average score for each of the four conditions was calculated. Each group's average score was then calculated by aggregating the average scores of the participants to derive the groups' average scores for Diversity of Opinion, Independence, Decentralization and Aggregation. The groups' average score for each condition was again aggregated to arrive at the final Wisdom of Crowds (WoC) score.

4 Results

This section analyses the outcome of the research by comparing each condition of Wisdom of Crowds with the actual performance of the groups. The correlations between each condition and the actual performance of groups in both tasks are compared. Out of 61 students who enrolled in Innoweek, 46 participated in the survey. Even though the course was open for students from all the degree programs, the business students outnumbered the others with 20 from the Degree Program in International Business and 17 from *Liiketalouden ammattikorkeakolututkinto* - the Bachelor of Business Administration program taught in Finnish.

4.1 Definitions

During the research, various terminology was created to explain the calculations. These terms and their mathematical meanings are explained in this section.

Actual Rank: The actual rank was derived from the results of Innoweek. The participating groups were ranked from first to last based on the scores they received from the judges.

Diversity of Opinion Rank: Ranking of the groups from first to last based on the Diversity of Opinion score.

Independence Rank: Ranking of the groups from first to last based on the Diversity of Opinion score.

Decentralization Rank: Ranking of the groups from first to last based on the Decentralization score.

Aggregation Rank: Ranking of the groups from first to last based on the Aggregation score.

Wisdom of Crowds (WoC) Rank: Ranking of the groups from first to last based on the overall WoC score. WoC score was calculated by averaging the scores of the four conditions.

Task 1: The task commissioned by Commissioner 1

Task 2: The task commissioned by Commissioner 2

4.2 Correlations

In order to establish the relation, if any, between the four conditions of wisdom of crowds and the actual performance of the groups, Spearman's Rank Correlation was used. Spearman's Correlation is used to measure the degree of correlation between two sets of observations or between paired values when the relative order of magnitude is given for each series [9]. The scores for each of the four conditions were ranked from first to last and compared with the actual rank using the Spearman's Rank Correlation Coefficient formula.

$$\rho = 1 - \frac{6\Sigma\, d^2}{n(n^2-1)} \tag{1}$$

where, n = number of items being ranked, d = the numerical difference between corresponding pair of ranks, (Xi - Yi) [10].

The value for Spearman's Coefficient (also known as Spearman's rho and denoted by 'ρ') ranges between -1 to +1. When ρ is >0, it indicates the positive correlation; when ρ is <0, it indicates the negative correlation in the order of ranking or selection or judging. The strength

of the Spearman's Correlation Coefficient can be interpreted as follows using the absolute value of ρ:

4.2.1 Diversity of Opinion versus Actual Rank

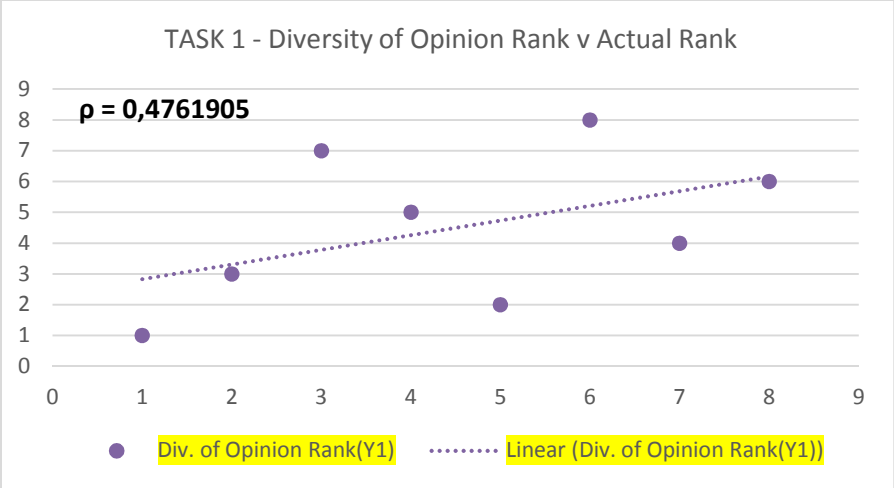

Fig. 1 *Diversity of Opinion versus Actual Rank for Task 1*

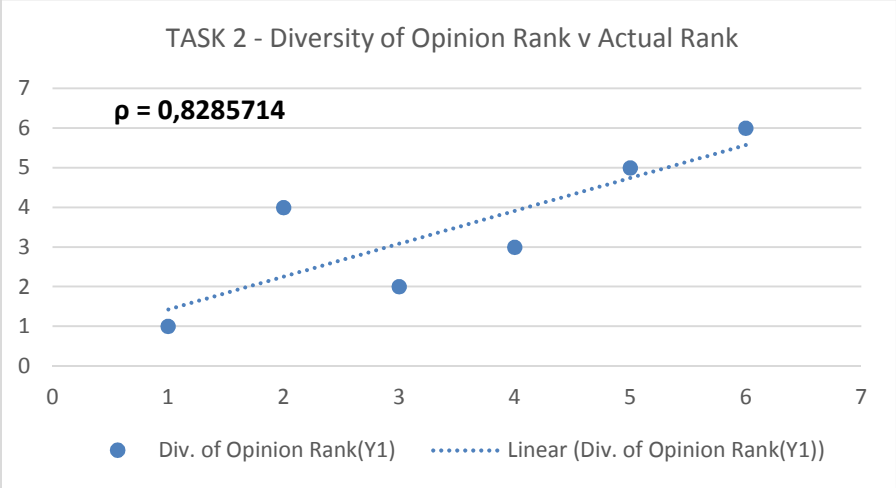

Fig. 2 *Diversity of Opinion versus Actual Rank for Task 2*

These graphs exhibit the correlation between the Diversity of Opinion and the Actual Rank in the two tasks. The positive value of ρ indicates the positive correlation between the Diversity of Opinion and the actual performance of the groups. The groups in both tasks exhibited increase in the actual performance when there was increase in the diversity of opinion. Task 1 with the ρ value of 0,4761905 (see Fig 1) indicates a moderate positive correlation while Task 2 displays a very strong positive correlation with ρ value of 0,8285714 (see Figure 2). This suggests that the groups with higher diversity of opinion performed better in their task. The teachers supervising the students during Innoweek tried their best to make sure the students came from different degree programs and nationalities while forming groups. This heterogeneity of backgrounds ensured the diversity of opinion in groups. Thus, the more diverse groups evidently performed well in their task.

4.2.2 Independence versus Actual Rank

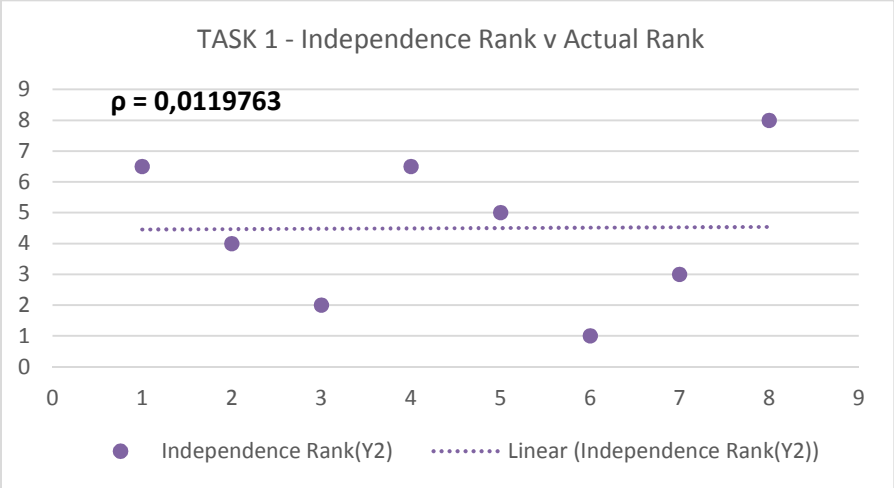

Fig. 3 *Independence versus Actual Rank for Task 1*

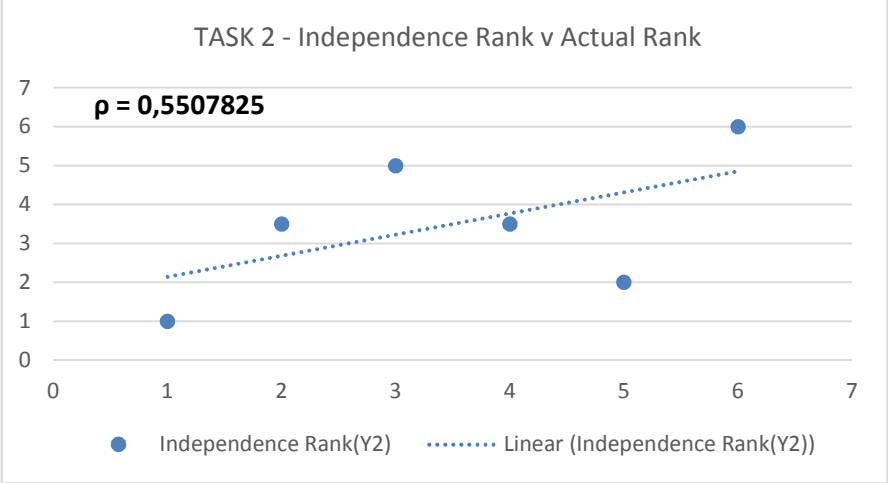

Fig. 4 *Independence versus Actual Rank for Task 2*

These graphs demonstrate the correlation between independence and performance of the task. The Spearman's Correlation Coefficient for Independence Rank versus Actual Rank for Task 1 is 0,0119763 (see Figure 3). This suggests that there is a very weak positive correlation between the two. Ideally, the more independent the group members are, the better the outcome of the task. It can be observed that the groups in Task 2 adhere to the postulation of Wisdom of Crowd more than the groups in Task 1.

4.2.3 Decentralization versus Actual Rank

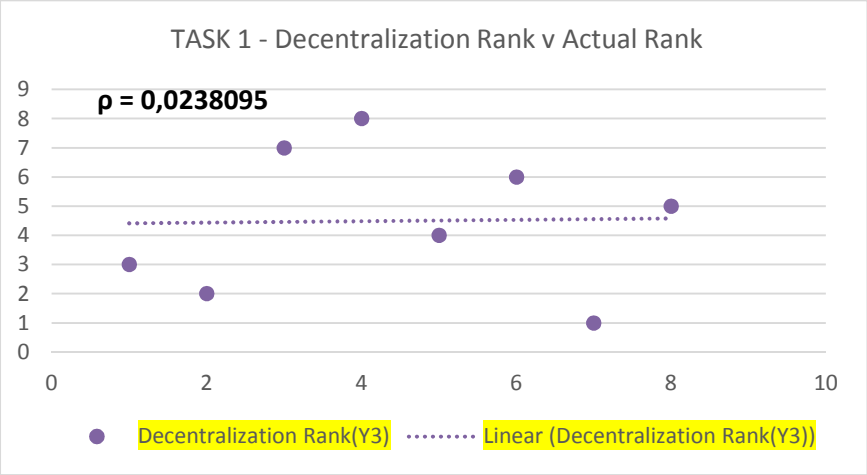

Fig. 5 *Decentralization versus Actual Rank for Task 1*

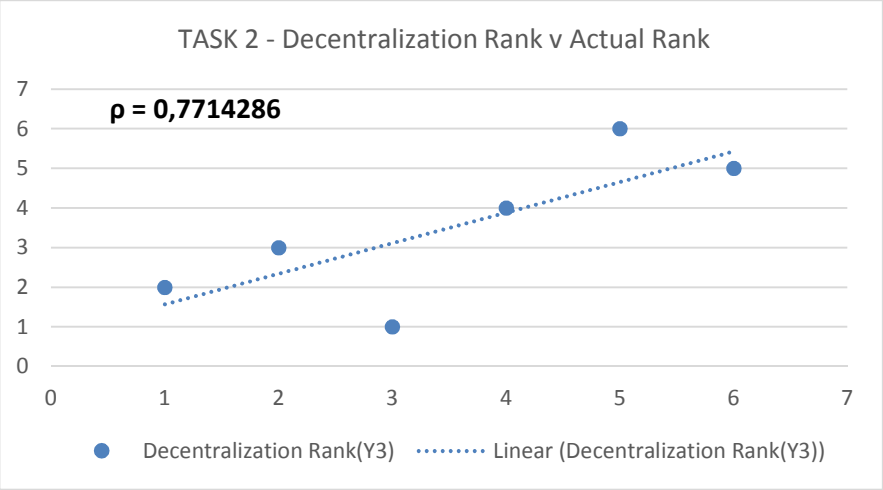

Fig. 6 *Decentralization versus Actual Rank for Task 2*

These graphs demonstrate the correlation between independence and performance of the task. The Spearman's Correlation Coefficient for Independence Rank versus Actual Rank for Task 1 is 0,0119763 (see Figure 3). This suggests that there is a very weak positive correlation between the two. Ideally, the more independent the group members are, the better the outcome of the task. It can be observed that the groups in Task 2 adhere to the postulation of Wisdom of Crowd more than the groups in Task 1.

4.2.4 Aggregation versus Actual Rank

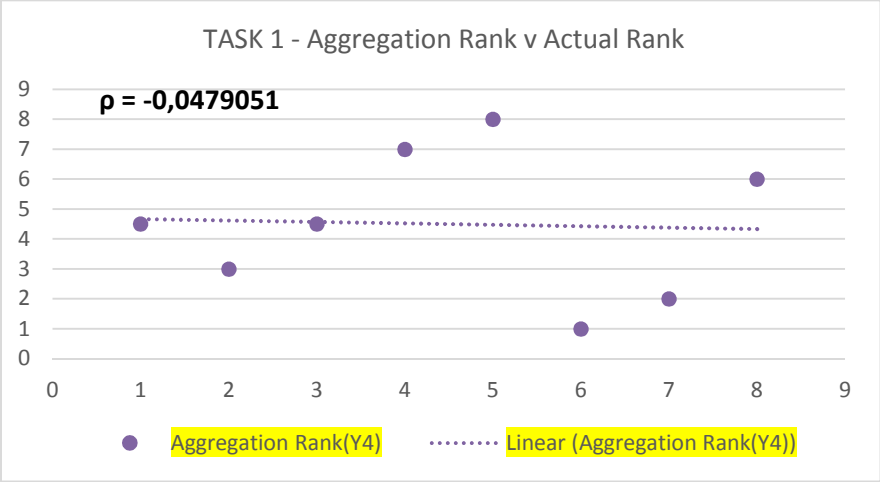

Fig. 7 *Aggregation versus Actual Rank for Task 1*

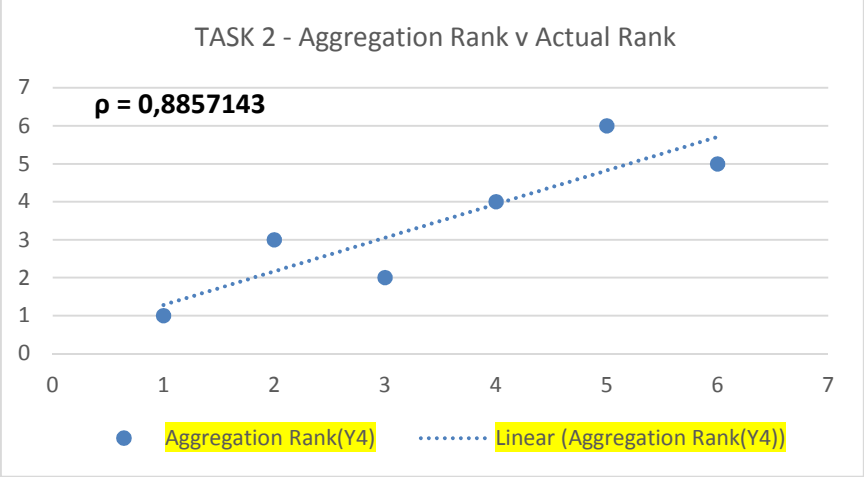

Fig. 8 *Aggregation versus Actual Rank for Task 2*

When the Aggregation Rank is compared with Actual Rank using the Spearman's Rank Correlation Coefficient, the groups in Task 1 display a very weak negative correlation with the ρ value of -0,0479051 while the groups in Task 2 demonstrate a very strong positive correlation with the ρ value of 0,8857143 indicating better performance by the group that exercised higher level of participative decision making.

5 Conclusion & Discussion

James Surowiecki argues that when a group of individuals working together satisfy the four conditions: diversity of opinion, independence, decentralization and aggregation, they perform better than an individual. Through his book "The Wisdom of Crowds", upon which this study is based, Surowiecki uses real life examples to show that the average opinion of groups is often more correct than most individuals in the group. This hypothesis was examined on the students working in groups for Innoweek. The results showed that the groups working on one task abided by the hypothesis while results of the groups working on the other task did not comply.

This study was built upon the premise that a group performs better if the four conditions of diversity of opinion, independence, decentralization and aggregation are met. When we examined the hypothesis on the groups in Innoweek, two contrasting results appeared. The groups performing one task did better only when they had higher diversity of opinion while the groups performing another task did better when they had higher diversity of opinion as well as higher independence, decentralization and aggregation. This means that the groups performing the second task followed the Wisdom of Crowds but the ones performing the first task did not.

The conflicting outcome of the research may be due to certain factors pertaining to the nature of the tasks and statistical shortcomings. The first task challenged the students to come up with plans to commercialize a company's various products. This might have affected the independence among group members as their scope of performance was in some way limited to the products' features and the company's guidelines. The second task, on the other hand, challenged students to come up with a plan to increase the voter turnout during OSAKO's annual student union elections. This was more of an open task, where the participants' scope was not limited, enabling them to come up with any kind of ideas.

The four conditions were examined individually against the actual performance using the Spearman's Rank Correlation Coefficient, where each group's scores were ranked from first to last and compared with the actual results of Innoweek. This rank versus rank correlation displayed the effect any or all of the four conditions had on the actual performance. According to the results, the groups working on the task commissioned by PrintoCent only performed better when there was higher diversity of opinion. These groups did not perform better when they had higher independence, decentralization or aggregation. On the other hand, the groups working on the OSAKO's commissioned task performed better when they had higher diversity of opinion, independence, decentralization or aggregation. Since Diversity of Opinion is a common theme of better performance of the groups, it could be said that groups perform better when members of the groups contribute with unique information and perspective they have.

The research was limited by various factors. The low number of participants affected the quality of data hindering the chances to attain optimum heterogeneity in groups. For future research, the experiment can be conducted in an organizational setting with a much larger group of people, thus ensuring higher diversity of opinion, independence and decentralization. A more scientific approach should be taken when measuring the conditions of wisdom of crowds and assessing the performances. The same experiment can be repeated multiple times with different sets of data to obtain any conclusive outcome.

Innoweek, being a school task, was in some manner limited to various parameters enforced by the course and thus hindering the independence factor among the participants. All the participants of the survey were students. The grading scale of the course was pass or fail. Working harder than others did not ensure a better outcome for them. This may have

discouraged some students from performing at their optimum level. The methodology used to collect data for the study might also have been unscientific. The survey questions might not have been able to provide a true view of the groups' performance as it was completely dependent on the participants' opinions. Response bias could have also affected the results. Since they were asked to score their own work during the survey, they might have rated themselves higher.

The two tasks were judged by their corresponding commissioners. The judges might have had differing judgement criteria. The lack of a scientific mechanism for the judges to evaluate the participants' performance and consequent subjective judgement by them could also have affected the outcome. Another reason could be the number of participants and groups. The first task had more participants than the second task. About 85% of the participants working on the first task participated in the survey while only 69% of those working on the second task answered the survey. This disparity in the number of participants might also have affected the outcome of the study. Inclusion of qualitative data could have improved the results. Interviewing some participants could have given a detailed perspective on the nature of the tasks allowing better understanding of the disparity in the results.

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Industry 4.0 as the Culprit of Unemployment

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Abstract: The exact definition of Industry 4.0 does not exist yet. Nevertheless, the meaning of number 4 is very well known. It represents the fourth stage of industrial revolution and is linked to spread of the Internet and digitalization. It is expected of the production to be fully controlled by robots in the near future and it is assumed that this fact shall lead to job losses. The article argues about threat of unemployment caused by the arrival of Industry 4.0.

Keywords: revolution; digitalization; unemployment; Industry 4.0.

JEL Classification: J6; E0.

1 Industrial revolutions

When are we going to buy a car that will fly? When will we enter a shop where just robots will serve us? Is this science fiction coming soon? The humankind is in front of the door leading into a different world. Our lives, working and personal, are going to change. We do not know how much; we are not able to say yet where all these changes will lead and what they will cause. Are we going to have better existence? Will our living standard rise? Or will our lives fall apart due to these major changes, and will the technological change push the human being into a deep abyss?

The expression "industrial revolution" can be used in connection with four major changes in production that have affected human beings. Up until now, all important innovations can be pinpointed to four periods starting at the end of the 18th century. The first industrial revolution introduced James Watt's steam machine that helped to mechanize production and affected mainly textile industry, metallurgy, transportation and engineering. The second industrial revolution brought in electrification that assisted in mass production and, apart from rapid railway development, affected iron, steel, paper and rubber production [1]. The third industrial revolution introduced computers and put emphasis on customization. It started around 1960 and was accompanied by demand for skilled workers and production being moved to low wage countries [2]. The fourth industrial revolution smoothly followed the third one and its base is in digitalization. It is expected that within a short time period machines will be able to communicate thanks to the Internet. This stage is marked with self-management, where people mainly cooperate with robots, where people communicate through mobile phones and access to information is unlimited. This stage will cause the birth of a smart factory. Will it replace the human work as well and cause massive unemployment? Four stages of industrial revolution, together with their features and consequences, are summarized in Table 1.

Tab. 1 *Stages of industrial revolution*

Stages of industrial revolution	Industry	Features	Consequences
First industrial revolution - England (1750-1850)	• Transportation Steam machine by James Watt (1765) • Metallurgy • Textile • Engineering	• Abolition of slavery • Moving people to towns • Specialization • New technologies • Capital accumulation	• Urbanization • Rise of population • Higher standard of living • Social revolution
Second industrial revolution – Britain, Germany, USA (1870 - 1914)	• Engineering • Telecommunication • Chemical industry • Maritime industry • Business management	• Cheap coal • Electrification • Mass production	• Railroads • Iron and steel production • Wide usage of machinery • Paper and rubber production • Fertilizers
Third industrial revolution (since around 1960)	• Transport • Computers • Metal machinery • Medicine • Genetic engineering	• Digital manufacturing • New processes • Clever software • Novel materials • Dexterous robots • Zero emission transport	• Mass customization • Production in low wage countries • Demand for skilled workers • Renewable energy

Fourth industrial revolution – Germany (since around 2011)	• All industries • All economies • All disciplines	• Digitalization • Internet • New technologies • Self-driving cars	• Digital enterprises • Artificial intelligence • Unemployment?

2 Industry 4.0

The whole European Union has always been striving for industrial production to increase and return to Europe. It has been a trend to move production into countries with low cost labour for a long time, yet higher productivity brought back into Europe could compete with cheaper labour force. It is important to alter the way we produce; it is necessary to bring in more value, to minimise the cost, to make more output with less input. Industry 4.0 could help us to reach this target.

The name "Industry 4.0" originates from the German phrase " Industrie 4.0", indicating where the concept of this expression started and came from. It all began in 2011, when the German government decided to analyse the consequences of new technologies on the national economy, and results were later presented at the trade fair in Hannover in 2013 [3].

The fourth industrial revolution – as Industry 4.0 is known for - is evolving at a very fast pace. It affects every industry in every country and changes it brings will modify production, management and governance as well. Impressive progress has been made in artificial intelligence, for example, from software used to discover new drugs to algorithms applied to predict our cultural interests. Digital fabrication technologies, meanwhile, are interacting with the biological world on a daily basis. Engineers, designers, and architects are combining computational design, additive manufacturing, materials engineering, and synthetic biology to pioneer a symbiosis between microorganisms, our bodies, the products we consume, and even the buildings we inhabit. Like the previous three revolutions, this one has the potential to raise the global income levels and improve the quality of life for populations around the world. Tasks we are used to, such as buying goods, making payment, booking holidays or playing a game, can be done from the most remote places. It is expected that the cost of transport and communication will drop, logistics will be more efficient and trading costs will fade away. At the same time, workers might be replaced by technologies and that shall disrupt the labor market [4].

Industry 4.0 is known for its data volume and possibilities to use it effectively. Companies nowadays can collect more information and use it in a more beneficial way. The question is which data are the most useful? Where does leakage of data cause problems? In order to solve incoming problems, manufacturing leaders can use a "digital compass" that consists of 8 basic value drivers and 26 practical Industry 4.0 levers (Fig. 1). This could help companies to find the levers that are best suited to solve their particular problems [5].

It is expected that Industry 4.0 will lead to establishment of a cyber – physical system, or an intelligent factory. The main features of an enterprise that is considered to be influenced by Industry 4.0 are:

- Interoperability — machines, devices, sensors and people that are connected and communicate with each another.
- Information transparency — the systems create a virtual copy of the physical world through sensor data in order to contextualize information.
- Technical assistance — both the ability of the systems to support humans in making decisions and solving problems and the ability to assist humans with tasks that are both difficult and dangerous for humans.
- Decentralized decision-making — the ability of cyber-physical systems to make simple decisions on their own and become as autonomous as possible [6].

The 'digital compass' helps companies find tools to match their needs.

[1]Maintenance, repair, and operations.

McKinsey&Company

Fig. 1 *Industry 4.0 levers*

The question is: would computer-controlled and fully automatic production or services lead to critical job losses in the future? It is expected indeed that by 2020, up to 5 million people will have lost their jobs [7]. How will it affect the rate of unemployment all over the world?

3 Unemployment

Existence of unemployment is an economic problem. On one hand, an unemployed part of the population does not contribute to gross domestic product creation, and on the other hand, it puts pressure on the state budget spending due to the payment of unemployment benefits. In case of this production factor not being used, the country cannot reach its potential output and the economy usually falls into recession. Unemployment is not only related to economically measurable losses but it also causes various social consequences in terms of the decline of the standard of living of the unemployed person and his/her family. Subsequently, stress and fear develop, and they might lead to alcoholism and increased crime rate. The impact of unemployment on the individual and society depends to a large extent on the length of duration of the unemployment. Negative long-term unemployment is mainly caused by low qualifications or lack of experience and causes the unemployed and their families to be excluded from social relationships, and they often live on the verge of poverty. Difficulties in finding a job have a negative effect on self-assessment of a person; his/her self-esteem is diminishing, which can then lead to the feeling of inferiority. Long-term unemployed people lose their acquired skills, which they do not use, and gradually lose their working habits, which deepens the situation of the unemployed.

Unemployment can be classified according to several criteria. If we consider the question of willingness, we distinguish:

1. Voluntary unemployment - which oscillates around the level of the natural rate of unemployment. The number of those who do not work is lower or equal to the number of vacancies. Even though there is a sufficient supply of jobs, it is not attractive for the unemployed.
2. Involuntary unemployment - which occurs when the number of unemployed is higher than the number of vacancies. Demand for work is higher than the supply, which is most often caused by the cyclical development of the economy.

In terms of causes, unemployment is broken down into:

1. Frictional unemployment - which arises as a result of asymmetric information. It contributes to an optimal allocation of labor because it assumes that the employee leaves the original job in order to find a more suitable job position in which he would be more satisfied. It usually takes a very short time - between one to three months. This is temporary unemployment caused by workers' fluctuation.
2. Structural unemployment - is caused by the fact that offer of a certain type of work is not available in the area. This unemployment affects, in particular, inappropriate

groups of workers who are not interested in retraining, if necessary. Although there is a job offer, there are no qualified unemployed people who could be employed in these places. This type of unemployment is very often caused by the labor force being replaced by machines.

3. Cyclical unemployment - which is typical for the period of economic stagnation and decline. It is a natural consequence of limited production due to a decrease in demand for goods and services. This is typical macroeconomic unemployment, which affects, to a certain extent, all sectors of the economy. It is related to not using existing capacities due to problematic sales [8].

4 Robots versus unemployment

It is obvious that in case of manual work being replaced by robots, machines and plants, we talk about structural and involuntarily unemployment. Indeed, it is expected that in the next five to ten years, all repetitive and monotonous jobs will be occupied by robots and many people will become jobless. In China, over 60,000 workers were rendered jobless in May 2016, when Foxconn decided to replace them with robots in order to lower the labor expenses and make the workplace more efficient [9]. If other companies followed the pattern, it could backfire. Unemployed people have no earning power; lack of money lowers demand for goods and services, and that consequently leads to many bankruptcies.

A study from the United Kingdom confirms the same facts. It is assumed that over 10 million British are at a high risk of being replaced by robots within 15 years. Up to 30% of jobs in Britain are potentially under threat because of artificial intelligence. Sectors such as wholesale and retailing are in peril with around 2.25 millions of workers without jobs; 1.2 million are under threat in manufacturing, 1.1 million in administrative and support services and 950,000 in transport and storage. Education, health and social care are the sectors seen as least threatened by robots because there are tasks that can be hardly automated. At the same time, it is expected that women are not in such danger as men as they tend to work mainly in the health care, education and social sector [10].

Similarly, Martin Ford analyzed the impact of cyber systems and computers on human employment and came to interesting conclusions. He claims that artificial intelligence, automatic machines and software programs will no longer primarily affect low-wage, uneducated workers, but enter as well those working positions that expect studying and education. At the same time, those university educated individuals will be able to perform sophisticated analysis and decision making. He came into conclusion that the result of this development is likely to be structural unemployment that will definitely hit the workforce in nearly all working positions from workers without diplomas to those who have studied and reached the graduate degree [11].

Due to this revolution, the banking sector is in jeopardy as well. The chief executive of Deutsche Bank warns about the impact of technology that will cause the staff to lose their jobs as robots take over. In the future, the banking industry will not need as many people as today. On the other hand, automation might lead to improvement in jobs. For example, it takes an accountant from three to four weeks to produce an account. If a machine could do it faster, then accountants could focus on analysis of results instead[12].

On the other hand, German companies have the contrary approach. Germany is one of the most digitalized countries with 200,000 robots at its disposal; yet, the level of unemployment

reached only 6% in 2016. Obviously, the demand for skilled workers has been changing; laborers are expected to gain new skills and must learn about modern procedures and shift their focus in the new direction. The most modern factory of Siemens EWA in Amberg, for example, has increased its production almost 7 times thanks to robotization, and it has reached the accuracy of 99.9966%, which is the world record within comparable enterprises. What is more, the number of its staff of 1,100 has not changed that much; they have only changed job description. Instead of putting computers together, they focus on development, design and production planning [3].

5 Conclusions

Nevertheless, the risk we are facing in the near future is higher unemployment within certain areas, affecting mainly low-skilled jobs. Obviously, those with high school diplomas and university degrees are not at peace either. The trend to move forward and come with new software, machines and technologies will flourish further, and the incoming job losses must be approached seriously. It is clear that people without jobs cannot produce spending power, and what is more, they put higher pressure on the social system. Money paid to the unemployed must be found somewhere, and this is usually solved through higher tax burden. The task is to think about these threats and to adapt to them as fast as possible in order to ensure a better future for the humankind.

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Improving the intranet

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Abstract: Typical problem with intranet applications is the vast amount of knowledge included in the system. This example discusses the development of a possible new student intranet but the principles can be generalized also to other kind of organizations, e.g. to SME companies.

The users of the student intranet represent different fields of studies and students from different backgrounds related to their age and study situation. Some are normal young full time students, the others adult students making online studies while working.

Now and in the future, the real-time requirements are more and more important. The schedules of the online studies are hectic and all information needs to be up to date and easily available. The intranet must serve all the users as well as possible regardless of the time and their whereabouts, thus the mobile versions of the system are vital. In order to meet these needs, a plan for the new mobile and workstation versions of the intranet is done.

User-oriented design method serves as the framework for the intranet design. It has different phases including user interviews, observations and analyses. Brainstorming session helps to create new ideas, and after it an affinity diagram is drawn to present the brainstorming results. Based on these visioning phases and a storyboard, a paper-model for the new intranet user interface is then created. The focus is on the system's ability to fulfil the needs of the user of the new intranet.

Keywords: intranet, user-oriented design, contextual design, knowledge management.

1 Introduction

The authors of this paper are the teacher and a student in the course "User-oriented Design" at Oulu University of Applied Sciences (Oamk). In this paper we are going to deepen our knowledge on some issues related to the usability of intranet applications and consider the possibilities for improving the user experience (UX) when using the intranet. As an example case we are using the student intranet at Oulu University of Applied Sciences but the principles can be generalized also to other kind of organizations, e.g. to SME companies.

Typical feature for intranet applications is the vast amount of information stored in it. Student intranet has a lot of different kind of users. Students from various disciplines have different needs and there are nowadays many more study forms besides regular daytime studies, such as online studies and different self-study forms are also common. Online studies are very tightly scheduled and require correct real-time information to be easily found from the intranet. Intranet must serve all students well regardless of the study form, place or time. This paper considers a mobile version and a new desktop version of the student intranet.

Framework for the paper is user-oriented design process called contextual design [1]. The process includes various phases starting from user interviews, making observations and interpretation. Brainstorming kind of working methods are used to generate features of the new intranet which is then documented on an affinity diagram. Based on these visioning phases and a storyboard a paper prototype for the new user interface is created. Focus on the development is to fulfil the needs of the intranet users by introducing user-centric design methods.

2 Interviews and interpretation

The design of a new user interface for the intranet is started by an analysis of the user-experience (UX). The application is given to a user (users) for evaluation. The responses of the user are monitored and the feedback is recorded. User opinions on the functions and details are asked for and recorded. The goal is to see and understand the functionality of the intranet and especially the possible problems and failures to operate it. These contextual interviews should be done with several users from various user categories.

2.1 Contextual interviews

First one person who has experience in intranets was asked to test the existing student intranet. He gave some spontaneous opinions in an interview that lasted abt. 15 minutes. Some predefined questions were used to stimulate the discussion.

General view on the intranet

"The first impression is that the user interface looks clear to use. The issues are well grouped and the necessary links are well presented. The action bar at the top of the page fits for the purpose. The profile of the user is well shown. The entity gives rather positive impression."

The structure and visual-aesthetic appearance

"The layout of the front page looks good. The block distribution could perhaps be divided into two columns. It might make it easier for the user to find what he needs. The structure

looks anyhow quite well functional and there is no need to start digging out for the information. The color appearance looks discreet. The colors are coming nicely "out", they are not too strong and they support the readability and making observations. The green color is relaxing and the orange is a good contrast. The user interface is at the same time relaxing and attracts attention."

Needs for development

"Even though the page gives more positive feeling than negative, there are still things to be improved. The most important thing is the big amount of information. From a big amount of information it is hard to find what you are looking for. I think that at the right hand side column the items could be categorized and presented for example by visual buttons. Generally there could be more pictures on the page through which the user could find instructions of use given by short videos. For the learning delta a visual window structure would be good."

2.2 Interpretation

Based on the observations and notes from the interviews a summary for the development of the new user interface is drawn. The interviews reveals the key issues and insights of the present application. On top of these the interpretation of the user experience leads to the goals for the development of the new user interface. By focusing on the solving of the problems of the present application a new and user-friendly intranet can be created.

2.2.1 Why user interface needs to be improved?

Besides of the many good features of the present intranet the vast amount of information on the front page was revealed in the interviews. The big amount of material on the front page makes somewhat disorganized feeling even though the information is rather well categorized. On top of this there are plenty of functions which are not needed by some users. This could be made better by allowing the users to assimilate the page contents according their needs.

According to the "Mobile first" principle [2], the application is designed for the small mobile screen and adapts from that onto larger screens when they are used. The present intranet is not yet "Mobile first". The major cause for the development need is the big amount of information. By reducing it and allowing the user to make personal assimilations, this flaw can be corrected. At the same time the user-oriented design is better achieved. Also the human-computer interaction (HCI) could be improved by implementing "mobile" features like text messages or sound "beeps" when important information is published on intranet. Similarly the teacher's messages for the online students could be given as text messages and sound alarms. Generally the real time requirements and the online interaction have become more important and should be strongly emphasized on the new system.

2.2.2 The development goals

The goals for the new development process must be set. For the new student intranet those are to set the amount of contents on a page to a right level, improving the possibility for personal assimilation, improving the use by mobile devices, improving the real time interaction, and as a whole making the system more user friendly. The user interface should give an overall positive impression. The items should be grouped logically, so that it will be

easy for the user to find what he needs by utilizing correct categories. The layout should be clear both with the smallest mobiles and the largest desk top screens.

The personal adaptation enables individual way of use. The user may select the most suitable functions based on his study profile (day- online- or open university student, and the field of study). Also services like lunch menus and sales announcements can be switched on or off. The goal here is to please the user by showing that the intranet wants to serve the user individually.

According to the "Mobile first" principle the new interface will be simple and easy to use. On the smallest mobile (phone) devices only the most important items (selectable) are shown. On a middle size screen (laptop) it will be possible to include more options, however maintaining the information clarity.

Improving the interaction is aimed at turning the intranet into a system which serves better the various study needs. Real time interaction between user groups (students, teachers, student services and other staff) is supported. Old information should be deleted and real time information on all changes, such as cancellations, time and location changes etc. is supported.

3 Affinity diagram

Affinity diagram is a tool to organize all ideas gained through user interviews and brainstorming sessions. Ideas, problems and possible solutions can be collected into a visual form within logical homogeneous groups. The goal of the affinity diagram is to create a limited number of consolidated groups of items and their relations with each other which will be helpful in understanding the problems and selecting the solutions. The method can be used together with brainstorming kind of processes when developing user interfaces and whole applications. [1], [3]

The affinity diagram created for the new student intranet is shown on Figure 1. It shows widely different kind of matters related to the new intranet. This intranet is strongly aimed at the service of the students because the staff has its own intranet user interface. For the students the most important matters are the course related items and the real time messages like cancellations and announcements. For the students the new intranet will be an information platform which delivers correct and real time information. Interaction services must be improved because the education is changing more and more out of the traditional lecture rooms. Instead there will be more online studies and studies based on connective learning. In connectionism [4] the studying is possible at the working places and real time communication is necessary.

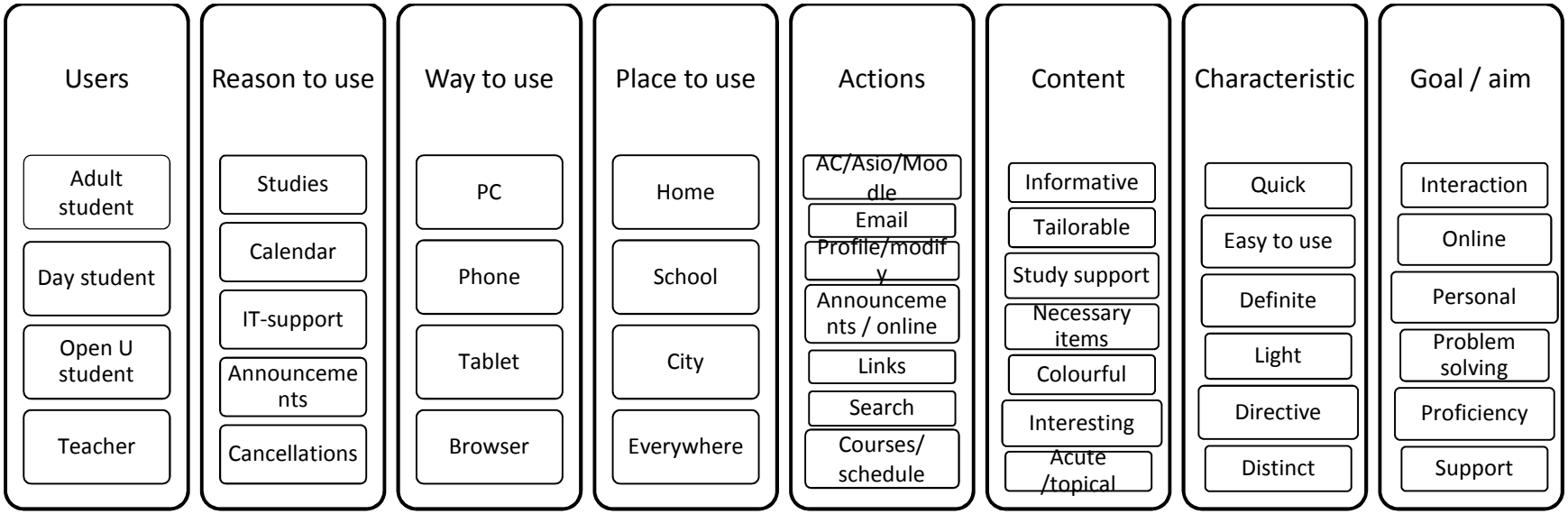

Fig. 1 *Affinity diagram for the mobile student intranet*

4 Story board

A story board is a cartoon type of presentation about how new product can be used. Story board is created on and follows the findings done on user interviews and interpretation. It shows the user in different phases of using the new product. Different viewpoints of the use can also be presented. [5]. Story board on figure 2 shows one example of the use of the new intranet.

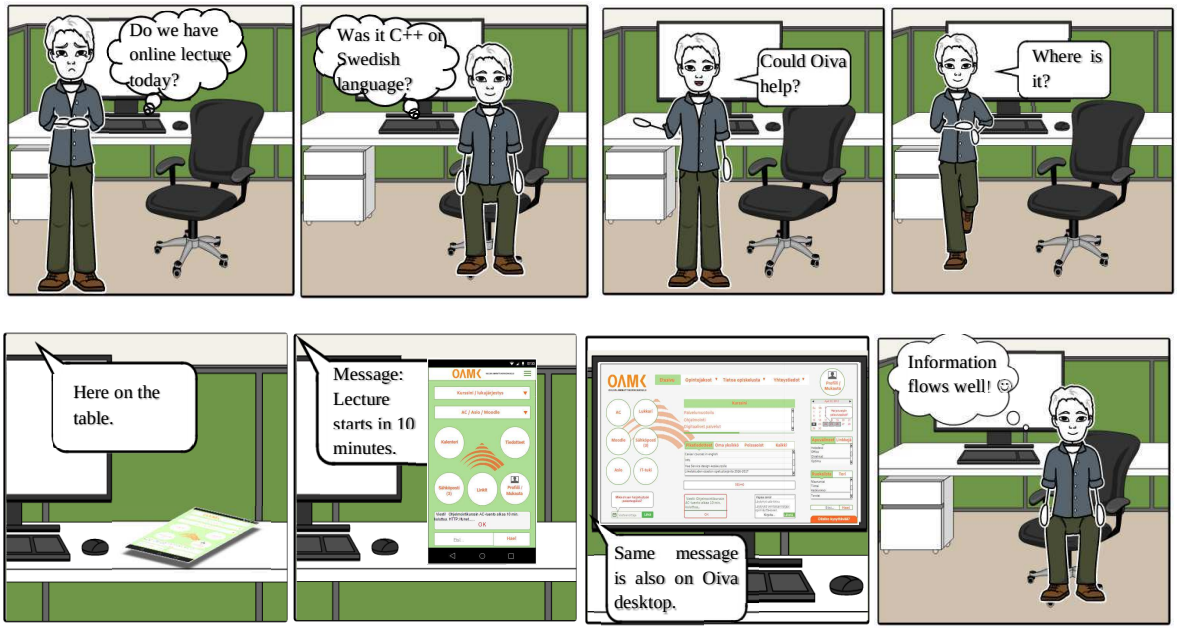

Fig. 2 *Story board example for new student intranet*

5 Paper mock-up

Three paper mock-ups were done and tested, and faults found were corrected. In the first version (fig. 3) there was no online messages and the layout was still not good.

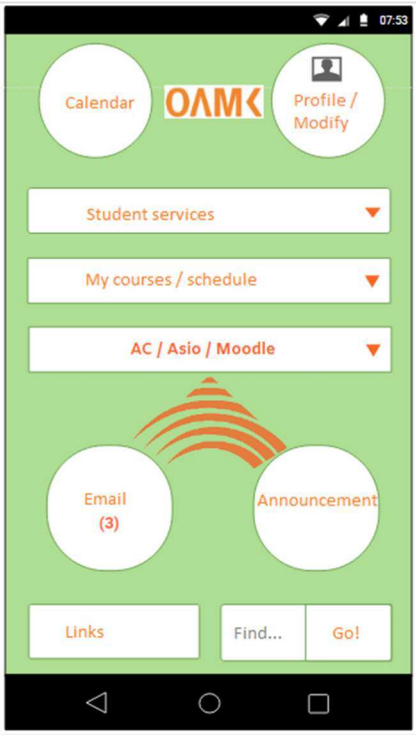

Fig. 3 *Mobile intranet ver. 1.0*

In the second version few elements were relocated and the Oamk top menu and message window were added.

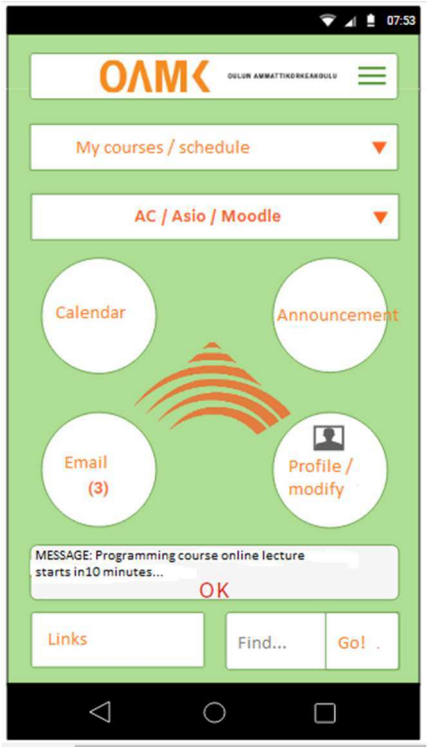

Fig. 4 *Mobile intranet ver. 1.1*

In the last version some more space was made free for other functions by relocating the Oamk menu. There are two drop-down menus on the front page.

Fig. 5 *Mobile intranet ver. 1.2*

In the desktop version of the intranet the most important aspects have been communication services and selecting/limiting functions on the front page. The communication must be real time and two-way. The restriction of the function visibility needs to be personal based on the students study field and own wishes. The whole front page must be visible without scrolling. Only one paper mock-up version is provided for the desktop user interface in figure 6.

Fig. 6 *Desktop intranet ver. 1.0*

5.1 Flow chart model

The front page of the user interface has only the most important services for the student. The student intranet must however contain also other study related information and therefore a lot of information is provided on lower level pages. Figure 7 shows a flow chart of the actions on front page menu. Mobile user interfaces contain only the necessary information. Copious text elements have been avoided.

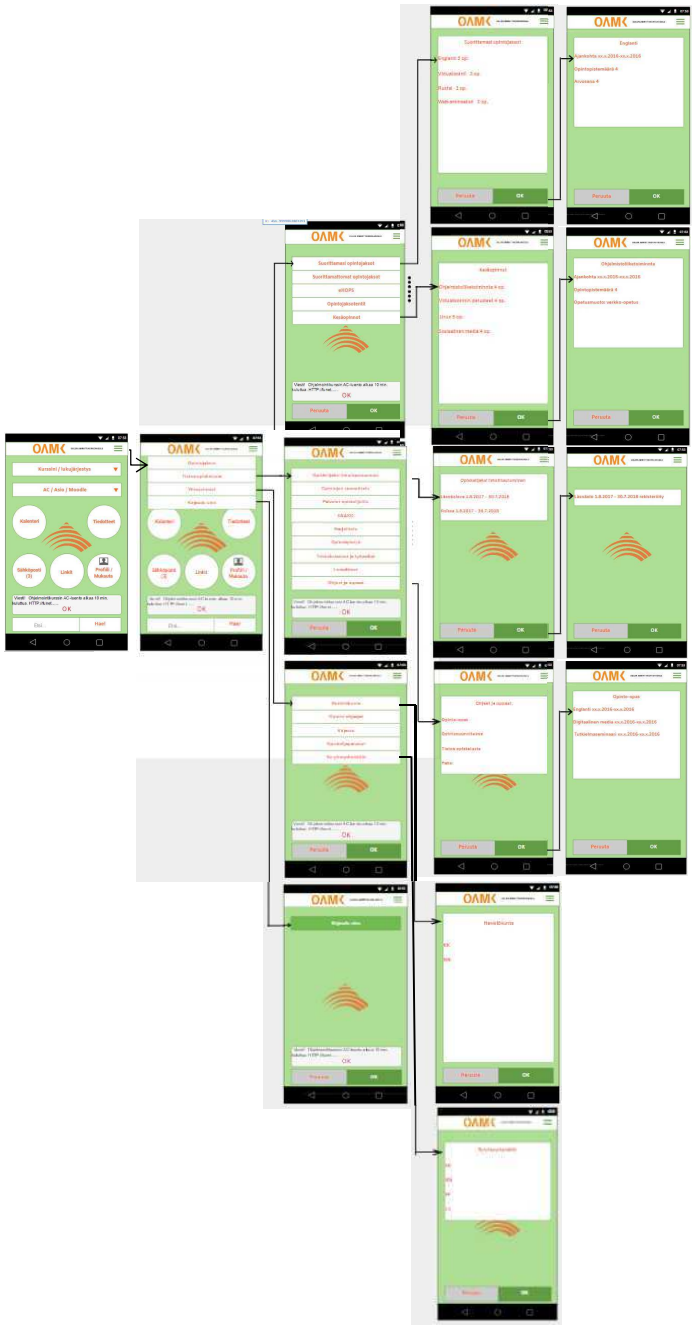

Fig. 7 *Flow chart of the menu actions*

6 Site map for the entire intranet

As the final step the site map for the entire new intranet application is created. It shows the structure of the new intranet through service categories shown as square boxes and their services shown as ovals.

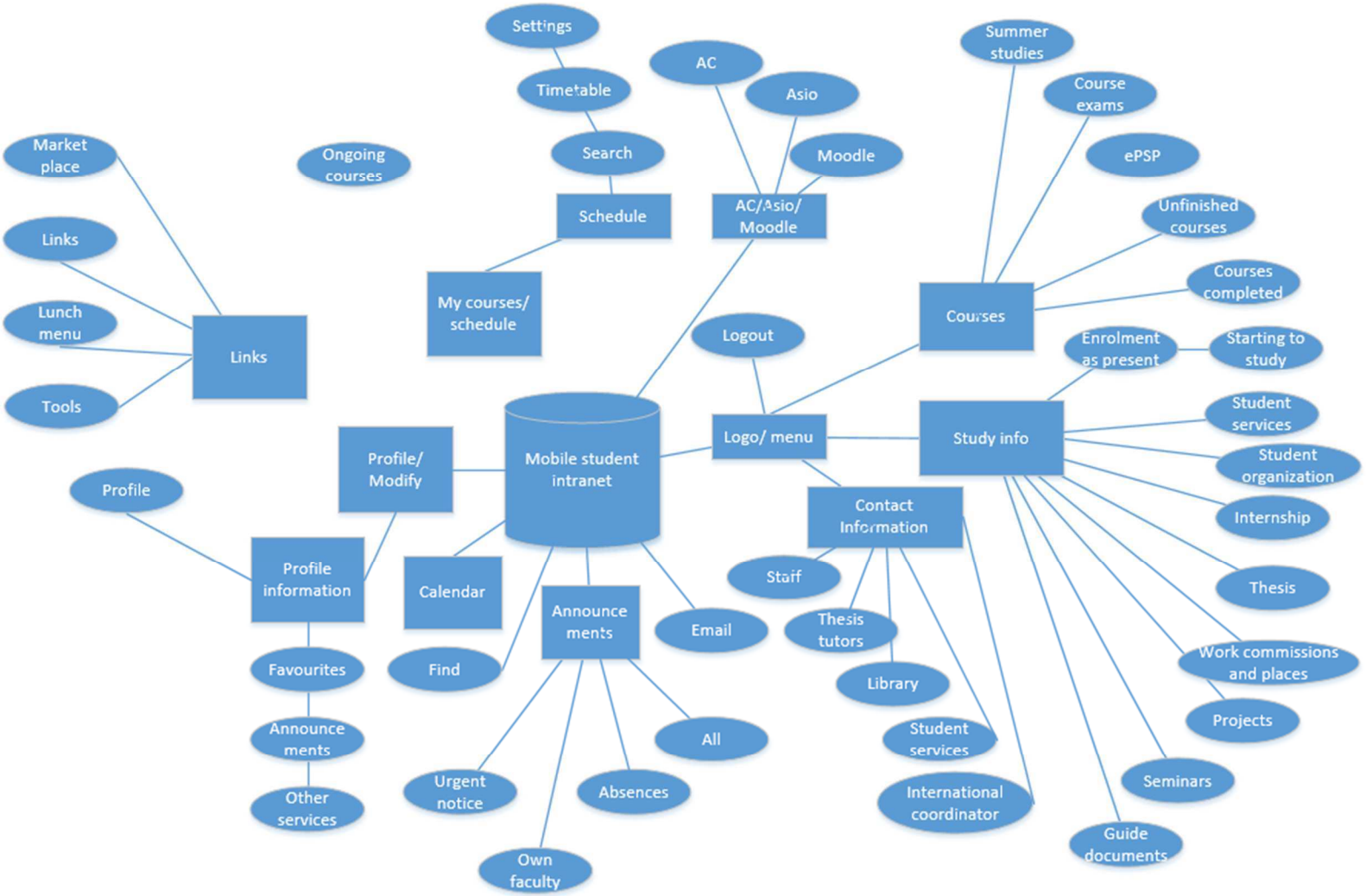

Fig. 8 *Site map for the new intranet*

7 Summary and conclusions

The paper gave a summation about the design process for improving an existing intranet application for university students as users. The method for the design work was user-oriented design method called contextual design. The aim was to present a better alternative for the existing intranet. Contextual interviews and interpretation gave new insight for the design. Based on the information gained through these an affinity diagram was created. The affinity diagram presented the features of the new intranet. Storyboard was used as an experimental method to demonstrate new features of the intranet. The development versions of the new mobile user interface were given as paper mock-ups. An example flow chart for one menu action was also shown. Finally, an example flow chart for one menu action and site map for the new mobile intranet is given.

When designing something new, it is important to see the present user needs and also the potential user needs in the future. In the future the students own responsibility on his study attainments will be increased, i.e. so-called self-study will be increasing. The studying will move more and more online and out from the lecture rooms. Therefore the materials and applications used for studying must be easily accessible and supporting real time service. Announcements and interaction must happen here and now. These are especially important for the mobile versions of the intranet. User-friendliness incudes that the user can tailor the interface according his needs and wishes. Personalizing can improve the usability and have a positive effect to the study results.

For the mobile phones a challenge is created by the small size of the screen. Many functions from the desktop version has to be left out and only the most important things can find a place on the front page. This is difficult because it is very typical for the intranet applications to have a vast amount of information and functions. For the mobile user interface the functions were restricted to the minimum.

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Internal Audit Assignment in the area of Enterprise Knowledge Management

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Abstract: The article deals with the steps, objectives and process of internal audit assignment of enterprise knowledge management in organization. The objective of the article is to propose a model of internal audit assignment in an organization based on the International Professional Practices Framework (IPPF) published by the Institute of Internal Auditors and implement it on an assignment focused on enterprise knowledge management. Besides the process of internal audit mission, the article proposes the main risks connected to the enterprise knowledge management and possible ways how to test these risks, as well as verification of risk management and the internal control system in this area.

Keywords: Enterprise; Internal Audit; Knowledge Management; Risks.

1 Introduction

Every business activity is connected with some risks. There are various types of risks which organizations are currently facing, e.g. strategic risk, operational risk, financial risk, compliance risk or reputational risk (Šimák, 2006). Due to organizational changes in the global business environment in the last century and the recent evolution in corporate governance, the internal auditing profession has evolved gradually with the progress of management and corporate governance. In the scope of internal audit, there are topics such as an organization's governance, risk management and internal control system, but internal audit frequently focuses also on efficiency and effectiveness of operations and compliance with laws (Dvořáček, 2003).

Organizations are not independent and isolated subjects on the market and they are strongly influenced by current trends in global economy. The related literature (Kuzmišin, 2010; Marthinsen, 2016) states that in the current market situation, organizations are under a lot of pressure of competition. The economic environment is turbulent and the economic development is unstable. Despite this, there are some movements which bring a change of business paradigm: globalization and digitalization. Today, as it was stated by Friedman (2005), because of globalization, the world might seem small and "flat" in several ways. Despite the fact that some of the globalization impacts might create such a perception, the global business environment is definitely more complex, dynamic and competitive and permanently creates new challenges for organizations (Petrík & Sedliačiková, 2016). Digitalization affects organizations on various levels. Today, companies capture and store tremendous amounts of information about every aspect of their business: their customers, partners, vendors, markets, and more. But with the rise in the quantity of information, there is corresponding decrease in its quality - a problem businesses recognize and are working feverishly to solve (Loshin, 2001, p. 28).

With the development and evolution of enterprise knowledge management, a new connection to risk environment and risk management of the company appears. It makes the

enterprise knowledge management an ideal candidate for ~~being~~ the subject of an internal audit assignment to ensure its effectivity and well-balanced risks.

2 Theoretical Background

In this section, the introductory and topic-relevant information will be defined, such as internal audit, its definition and process and enterprise knowledge management.

2.1 Internal Audit

According to the definition of Internal Auditing in the IIA's International Professional Practices Framework (IPPF), internal auditing is "an independent, objective assurance and consulting activity designed to add value and improve an organization's operations. It helps an organization accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control and governance processes."

Performed by professionals with in-depth understanding of the business culture, systems, and processes, the internal audit activity provides assurance that internal control in place is adequate to mitigate the risks, governance processes are effective and efficient, and organizational goals and objectives are met. The scope and focus of internal audit in an organization might be comprehensibly characterized by the following activities: evaluating emerging technologies, analysing opportunities, examining global issues, assessing risks, control, ethics, quality, economy, and efficiency. Such diversity gives internal auditors a broad perspective of the organization. And that, in turn, makes internal auditors a valuable resource to the executive management and boards of directors in accomplishing overall goals and objectives, as well as in strengthening internal check and organizational governance (The Institute of Internal Auditors, 2017).

There is not any unalterable audit process scheme. It varies from organization to organization depending on its own governance. Steps of performing an audit assignment might be generally defined as follows, in line with the IIA's International Professional Practices Framework (2017) and other sources, such as the Chartered Institute of Internal Auditors (2014):

- Establishing the planned scope of the audit assignment – it is very often based on the regular audit plan, or the decision to perform an audit assignment is the result of a management request.
- Conducting of interviews, meetings with the auditee, together with the request for introductory data to gain deeper understanding of the audited area. There are various sources of information.
- Based on the previous stages, specification of the final scope of the audit assignment, together with identification of the area to verify during audit. There is one goal: focus on the most significant risks related to the audited area.
- Performing audit fieldwork – so-called testing or verification phase. There are various activities performed in this phase in order to obtain audit evidence ~~and results~~ about audited risks and controls:
    - Discussion and observation of monitoring controls - The aim is to determine that the controls used by the management ensuring that the risk management

framework is working are designed to achieve this objective and to show that they are working as designed.

- Individual audit testing of pre-defined issues - These activities may also be required to provide extra evidence that responses to key risks.
- Conclusions on the internal control system and risk management processes covered by the assignment.
- Fieldwork encompasses all the efforts of the internal auditor to accumulate, classify, and appraise information so as to enable the auditor to form an opinion and to make any needed recommendations for improvement.

- Reporting and feedback (drafting of an audit report, confirmation by the auditee and a final audit report).

2.2 Enterprise Knowledge Management

To be able to conduct an audit assignment on the enterprise knowledge management in an organization, we must identify the assignment properly, including its various features in theory and practice.

According to Girard (2015), the knowledge management (hereinafter referred to as "KM") is the process of creating, sharing, using and managing the knowledge and information of an organisation. It adds value to achieving the organization's objectives by multidisciplinary use of the knowledge. The concept of knowledge management might be considered as new, as only two decades old. It was introduced and then established by Nonaka in the 1990s (Nonaka, 1994), mainly by the process of knowledge transfer. KM refers to identifying and leveraging the collective knowledge in an organization (Krogh, 1998). KM systems refer to a "class of information systems applied to managing organizational knowledge, and are developed to support and enhance the organizational processes of knowledge creation, storage, retrieval, transfer, and application, mainly at organizational (corporate) workplaces" (Barão, et. al, 2017, p. 735). The practical implementation of KM very often has a form of Knowledge Management Systems (hereinafter referred to as "KMS"). Ruzic-Dimitrijevic (2014, p. 1) stated that "A knowledge management system (KMS) is a system for applying and using knowledge management principles." This system consists of processes of knowledge creation and its transmission - knowledge transfer. By Benoit, et al. (2011) the KMS is collection of three subsystems:

- People interactions;
- Technology acting;
- Organizational structures.

Loshin (2001) identifies that data are some of the most important aspects of KMS in an organization. He proposes an easily adaptable methodology for defining, measuring, and improving data quality. In the current era of "big data", he requires understanding of the value of data quality; then he proceeds to outlining of data quality rules and domain-and-mapping-based approaches to consolidating enterprise knowledge.

In the current literature, the merger of risks, controls and internal audit with knowledge management is not very common. In her article, Ruzic-Dimitrijevic (2014) dealt ~~in her article~~ with the issues of risk management and knowledge management as the integral elements of

business management. Besides that, there are various articles on the relationship of knowledge management and audit, e.g. Lauer and Tanniru (2001), who deal with the knowledge management audit, or Rodgers, Mubako and Hall (2017), who focus on the knowledge management in audit engagement planning.

In the following text, the article will focus on the internal audit assignment of knowledge management and the knowledge management system in the enterprise.

3 Methodology

The objective of the article is to propose the general model of internal audit assignment in organization based on The International Professional Practices Framework (IPPF) published by The Institute of Internal Auditors and implement it on assignment focused on enterprise knowledge management.

The processing of the article was divided into three parts. First part was focused on the synthesis of the existing knowledge in the context of article's topic. To suggest the general model of internal audit assignment of enterprise knowledge management in organization, the literature review was created. Methods of summary, synthesis and analogy were used. Literature review stated the basic theoretical background and assumptions for further work. Results of first part are summarized in chapter 2 of the article.

Second phase focused on the empirical research. In order to test validity of qualitative research approach in the article, the triangulation of data sources was applied through the convergence of information from different sources. The methods of qualitative research were chosen: observation, semi-structured interviews and documents analysis (see following Fig. 1). Triangulation refers to the use of multiple methods or data sources in qualitative research to develop a comprehensive understanding of phenomena (Patton, 2001; Hendl, 2016).

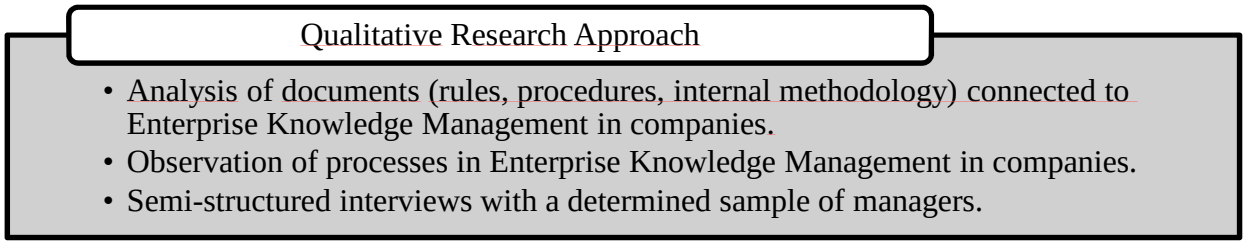

Fig. 1 *Qualitative Research Methodology*

Source: Author, 2017

In order to characterize general model of internal audit assignment of enterprise knowledge management, the chosen methods were applied in two different companies. As the article includes business-sensitive information about internal processes, the companies remained anonymous. Their characteristics were following:

- Company A: Privately held consumer financing company active in Slovakia, considered as a medium enterprise according to EU recommendation 2003/361.
- Company B: Privately held provider of internet connection and related IT services in Slovakia considered as a medium enterprise according to EU recommendation 2003/361.

There were 6 semi-structured interviews in total with managers directly or indirectly connected to the Enterprise Knowledge Management – with managers governing Enterprise Knowledge Management, but also with others who are the main and the most frequent users of Enterprise Knowledge Management. There were various processes considered, mainly in connection to IT systems, general function, perceived risks, implemented controls and involvement of human factor. Author was granted with access to some internal documentation.

In the third phase, the results of the research were synthetized and interpreted. Results and statements were obtained by the deduction method. Third phase also defined asset of article for theory and practice.

4 Results and Discussion

Based on the information presented in previous chapters, the goal of the audit assignment of enterprise knowledge management in organization is proposed as following: The goal of internal audit assignment of organization's enterprise knowledge management is to provide an independent and objective assurance that risk management, internal control system and controls together with strategic and day-to-day operations of enterprise knowledge management add value and help an organization to accomplish its objectives.

Internal auditor must be able to set limits to what is and what is not in the scope of the audit assignment. In case of KM, perhaps the following definition provides boundaries of steering so wide issue such as KM: "Knowledge management is a discipline that promotes an integrated approach to identifying, capturing, evaluating, retrieving, and sharing all of an enterprise's information assets. These assets may include databases, documents, policies, procedures, and previously un-captured expertise and experience in individual workers." (Koenig, 2012).

The conducted empirical research in case of two companies described in chapter 3 indicated that audit assignment should focus on several areas in context of risk management, governance and effectivity/efficiency. Audit assignment would require a multidiscipline approach, because KM itself is a "multidiscipline approach to achieving organizational objectives by making best use of knowledge" (AS5037, 2003, p. 7).

Gained results were compared and enriched by results other authors, e.g. Benoit, Bernard and Carlos (2011), Fehér (2002), and Jamieson and Loeng (2003).

Key identified risks and issues for audit fieldwork and testing are following, together with additional specifications:

- Fraud risk consideration – are there any experienced frauds connected to the knowledge management in company? Are fraud scenarios developed? Is fraud prevention in place? Are fraud red flags of knowledge stealing available?
- Access Rights – are there any controls for regular review of access rights to KMS? What are the rules for passwords and logins? Is activity in KMS traceable? The testing should focus also on verification whether former employees and transferred employees do not have access rights to KMS and other important IT systems.
- Data Quality – are there any controls over data quality to ensure that data management risks are identified and addressed. Is "bad data" defined and searched?

- Data ownership and business requirements - ensure that data responsibilities for business rules description are reasonably assigned and performed
- People – are for employees directly involved in KM and KMS set any (and correct) Key Performance Indicators and Key Risk Indicators? Are training plans correctly set (both for users and for involved employees)?
- Governance – is there adequate and well-known strategy regarding KM in a company? Is it based on the internal documentation and involvement of higher management? Is there sharing of information and collaborative culture (in the context of "need to know" concept).
- Evaluate the availability of information, navigation and searching of knowledge. How accurate is the searching for information?
- Data - data warehousing, data mining, and knowledge discovery
- Is the user support effective? Are complaints and recommendations of users reviewed?
- Assess the trust in the KMS and in information/data by users. Also focus on the management of user perception of the usefulness of KM.
- Assess the electronic (digital) knowledge database: physical security, possibility of data loss (viruses, system crashes, insufficient back-ups, and hackers), overload, interface problems, etc.
- Evaluate maintenance activities – frequency, adequacy and competency.
- Are there any controls within KM and KMS function? Are they need, effective and correctly designed? Do they cover main risks?

5 Conclusions

"Knowledge management is the focus of agile organizations and research has shown that an organization's competitive advantage is directly affected by its ability to create, identify, share, and apply knowledge" (Alavi & Leidner, 2001; Rodgers, 2016; Rogers, Mubako, Hall, 2017).

On one hand, there is no doubt that enterprise knowledge management and knowledge management system play and will play a significant role in ensuring productivity and competitiveness of organization. On the other hand, like any other activities of the organization, it might be a source of some risks with various probability and impact. Internal audit is able to address these risks and review the efficiency of knowledge management in organization.

There were various risk categories identified for potential audit assignment. The main results might be defined as data quality, knowledge stealing, maintenance, trust and user experience of knowledge database.

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Employee Satisfaction and Knowledge Management

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Abstract: This paper examines knowledge management, which is a way to nurture job satisfaction and examine how knowledge management can increase individual employees' job satisfaction. We propose a theoretical model concerning the connections between five facets of knowledge management and job satisfaction. Existence of knowledge management processes in one's working environment is significantly linked with high job satisfaction. Practical implications of knowledge management has strong impact on employee satisfaction, and therefore, managers should implement knowledge management activities in their organizations, not only for the sake of improving workers' performance but also for improving their well-being at work.

Keywords: Knowledge management; Job satisfaction; Organization.

1 Introduction

The most important means of production are intangible. The knowledge-based view puts a great emphasis on human capital – skills, knowledge, competences, attitudes and motivation of people working for an organisation and the way that they use these skills for the benefit of the organisation (Schultz, 1961; Crook et al., 2011). However, as human intelligence is tacit, embedded and at least partially individual, it cannot be simply "captured and codified", which makes its management problematic. It is necessary to suggest that the management of knowledge is usually connected to creating, providing, energising and supporting suitable knowledge environments within an organisation. Knowledge management is about how to motivate and enable knowledgeable individuals to use and share their knowledge and create new knowledge. The authors examine if and how knowledge management can be used to promote employee ~~job~~ satisfaction. They also suggest that knowledge management can nurture job satisfaction and, in so doing, foster high organisational performance. Several studies have demonstrated that job satisfaction, which is the extent to which an employee feels positively or negatively towards his/her job (Locke, 1976; Odom et al., 1990; Spector, 1997), influences employee motivation, organisational commitment, and, ultimately, the quantity and quality of performance (Petty et al., 1984; Bolon, 1997; Spector, 1997; Judge et al., 2001). Factors that support job satisfaction have been studied extensively, and the validated antecedents include, for example, job design, skill variety and role ambiguity. However, knowledge management issues have not yet been included among the many examined influencing factors. Although job satisfaction is the most researched topic in the field of organisational behaviour (Spector, 1997; Appelbaum et al., 2000), it has only rarely been approached from a knowledge-based perspective. We have organised the paper into 6 parts. In first part, we presented a model of the

connections between knowledge management and job satisfaction. We devoted the second part to five discussed facets of knowledge management: knowledge acquisition, knowledge sharing, knowledge creation, knowledge codification and knowledge retention. We formulated some hypotheses that concern the impact of knowledge management on job satisfaction. After that, we tested them empirically by analysing a survey data set of 411 observations, collected from the employees of a Slovak municipal organisation. We analysed the data by structural equation modelling, using the partial least squares package to examine connections between the study variables. Finally, we presented the results with reflection to theoretical and practical implications discussed.

2 Theoretical background

In the second chapter, we brought ideas and discussed the nature of job satisfaction and knowledge management practices. Then we created a framework of the research model and formulated hypotheses concerning the impact of knowledge management practices on job satisfaction.

2.1 Job satisfaction

Spector (1994) defined job satisfaction as the extent to which people like (satisfaction) or dislike (dissatisfaction) their jobs. The meaning of job satisfaction varies from the feelings a worker has about his/her job (Smith et al., 1969) to "an effective reaction to a job, which results from the incumbent's comparison of actual outcomes with those that are desired" (Cranny et al., 1992). Locke (1969) stressed that the job satisfaction has also been defined as "a function of the perceived relationship between what one wants from one's job and what one perceives it as offering" and as the extent to which an employee feels positively or negatively towards his/her job (Odom et al., 1990; Locke, 1976). The term job satisfaction is close to the concept of employee well-being. According to Grant et al. (2007, p. 52), employee well-being is the overall quality of an employee's experience and functioning at work. The definition includes three dimensions of well-being: psychological, physical and social. Well-being is a critical factor in both individual and organisational performance. The impact of poor well-being is reflected in under-performance, absenteeism, presentism, sick leave and turnover. Job satisfaction also relates to the discussion of motivation (Vroom, 1964; Hertzberg et al., 1959; Maslow, 1954), where the source of job satisfaction can be connected especially to social belonging, self-esteem and self-actualisation, at the top of Maslow's hierarchy of needs (Maslow, 1954). Vroom's (1964) expectancy theory hypotheses the situation with personality variables that in combination enhance job satisfaction. Expectancies are based on the worker's belief that effort will lead to strong performance, which will, in turn, lead to reward. Another concept closely related to job satisfaction is organisational commitment, which can be defined as attachment to the organisation, characterised by intention to remain in it, identification with the values and goals of the organisation and willingness to exert extra effort on its behalf (Porter et al., 1974). Commitment binds an individual to an organisation and thereby reduces the likelihood of turnover (Meyer et al., 2004). It has been demonstrated that job satisfaction strongly impacts organisational commitment (Bolon, 1997). Job (dis)satisfaction is usually defined as a negative or positive judgement regarding one's job situation (Weiss & Cropanzano, 1996). According to Blum and Naylor (1968; Gustainiené & Endriulaitiené, 2009), job satisfaction is general attitude among workers, which incorporates their feelings about wages and working conditions, control mechanisms, promotion related to the job, social relations at

work, recognition of talent and other similar variables, personal characteristics and group relations outside work. Employee´s performance is determined by their competency, motivation and organizational support. This has an impact on the factors that contributes to job satisfaction rate. Employee´s job satisfaction determines the number of objective and subjective factors (Kozelová, 2016). Job satisfaction is an accumulation of sentiments related to the job being performed. If people believe that their value is appreciated within the job, they develop a positive attitude towards it and experience satisfaction (McCormick & Tiffin, 1974). It is possible to increase job satisfaction by ensuring fair and satisfactory performance appraisals, reward systems and benefits. According to Herzberg (1968), the opposite of job satisfaction is not dissatisfaction, but rather a simple lack of satisfaction. Many studies have argued that an individual will stay when a job is satisfying, but will leave a dissatisfying job (Judge et al., 2005; Locke & Latham, 2002). Irvine & Evans (1995) note that the characteristics of work content–such as routinisation, autonomy and role conflict – and the work environment – such as leadership, supervisory relations and participation – all relate to job satisfaction. Job satisfaction has been widely studied in connection with various organisational and individual characteristics including organisational commitment (Currivan, 1999), performance, organisational culture (Lund, 2003) and age/gender. However, very few existing studies have related knowledge management to job satisfaction (Lee & Chang, 2007; Koseoglu et al., 2010; Almahamid et al., 2010; Singh & Sharma, 2011). This kind of approach seems to be quite new.

2.2 Knowledge management practices

Knowledge management refers to identifying and leveraging the collective knowledge in an organisation to help the organisation compete (von Krogh, 1998). Generally speaking, knowledge management consists of knowledge processes (such as knowledge creation, sharing, acquisition, transfer and application) together with infrastructures, capabilities and management activities that support and enhance the knowledge processes (Lee & Choi, 2003).

The literature on knowledge management includes several categorisations, practices and activities. For example, Nonaka & Takeuchi (1995) divide knowledge management practices into knowledge creation, incorporation and dissemination. Demarest (1997) proposes four knowledge management processes: knowledge construction, embodiment, dissemination and use. Alavi & Leidner (2001) discuss knowledge creation, knowledge storage/retrieval, knowledge transfer and knowledge application. In sum, the literature typically identifies four to six interrelated knowledge processes that are cyclical (Nonaka & Takeuchi, 1995; Demarest, 1997; Alavi & Leidner, 2001). Similarly to these views, knowledge management processes can be divided into five main types: knowledge acquisition, knowledge sharing, knowledge creation, knowledge codification and knowledge retention.

Knowledge acquisition stands for organisational practices aimed at collecting information from extra-organisational sources (Cohen & Levinthal, 1990; Zahra & George, 2002; Darroch, 2005). External networks and collaborative arrangements are important sources of knowledge for all types of organisation. Customers form an especially important group from whom knowledge should be acquired if the organisation is to succeed. For example, customer feedback systems, data mining, business intelligence and collaboration with partners and research institutions are typical of highly developed knowledge acquisition practices.

Tacit knowledge is embedded in human experiences and shared in social interaction. Although some tacit knowledge may be codified, much will remain tacit. The only way to share it is in face-to-face interaction (Nonaka & Takeuchi, 1995); knowledge sharing is the key for

managing tacit knowledge. Therefore, organisations should also encourage frequent face-to-face communication and creation of shared learning experiences, as well as build a knowledge-sharing culture (Nonaka & Takeuchi, 1995; Ståhle & Grönroos, 2000; Carpenter & Rudge, 2003; Dalkir, 2005). Knowledge-sharing activities include informal communication, brainstorming sessions, mentoring and coaching (Filius et al., 2000).

Knowledge creation refers to the organisation's ability to develop new and useful ideas and solutions regarding various aspects of organisational activities, from products and technological processes to managerial practices. Knowledge creation is a key factor in enabling sustained performance in turbulent environments (Teece et al., 1997; Eisenhardt & Martin, 2000). Knowledge is created when an organisation and its members learn and innovate. Knowledge-creating organisations arrange for the development of potential and self-transcending knowledge to cultivate radically new insights (Scharmer, 2001) and promote innovation and idea development at all levels of the organisation.

To allow for the re-use and integration of knowledge, its codification and storage is also important. Knowledge codification consists of activities needed to codify tacit knowledge into an explicit form, to store documented knowledge and to provide up-to-date documented knowledge to others in the organisation (Filius et al., 2000). It is based on availability of appropriate communication and information technology tools, platforms and systems, together with the related employee skills and motivation to use them to make employee knowledge explicit and to codify and store it for use in company systems and documents. Ideally, employees should be equipped with information technology tools and platforms that facilitate the effective codification and storing of explicit knowledge in databases and manuals, as well as the search and transfer of this knowledge.

Finally, knowledge retention refers to activities related to managing personnel turnover and the associated loss of expert knowledge – a key strategic resource. Expert knowledge can be lost when employees leave the organisation for one reason or another. As baby boomers retire, attracting and maintaining the best employees will become an even more pressing challenge with regards to knowledge retention.

2.3 Knowledge management as a means of improving job research model

Job satisfaction is one of the most researched topics in organisational behaviour literature and has been actively studied since the 1930s. The prerequisites for high job satisfaction have been widely studied, and the validated antecedents include, for example, job design, skill variety and role ambiguity (Glisson & Durick, 1988). Nevertheless, knowledge management issues have not yet been included among the many job satisfaction factors to be examined. In general, it seems that knowledge management literature has only rarely addressed the impact that knowledge management can have on "soft" performance issues, such as job satisfaction.

In the literature review, the authors found only four previous papers that had explored the relationship between knowledge management and employee job satisfaction (Koseoglu et al., 2010; Almahamid et al., 2010; Lee & Chang, 2007; Singh & Sharma, 2010). Lee & Chang (2007) examined the relationship between employee job satisfaction and knowledge management in an electric wire and cable group in Taiwan. The results of their study demonstrate a mutually positive correlation between job satisfaction and knowledge management. Singh & Sharma's (2011) research into Indian telecommunication industries also showed a positive association between knowledge management and employee job satisfaction. Almahamid et al. (2010) focused more closely on the impact of knowledge sharing on job

satisfaction in a sample of 160 employees in Jordan. Their study demonstrated that knowledge-sharing practices significantly impact employees' job satisfaction. However, Koseoglu et al. (2010), who examined the relationship between knowledge management (knowledge sharing and knowledge transfer) and job satisfaction among 154 luxury hotel employees in Turkey, failed to find a connection between knowledge management and job satisfaction. In sum, it can be stated that existing research evidence on the relationship of knowledge management and job satisfaction is rather scant and inconclusive.

According to psychological expectancy-based job design theory (Hackman & Lawler, 1971; Hackman & Oldham, 1975), particular task attributes lead to an individual sense of meaningfulness, responsibility and knowledge of results, which, in turn, promote job satisfaction, as well as work motivation, performance and effectiveness (Hackman, 1977). In the current knowledge era, knowledge management processes constitute such contextual features of the work environment, which can enrich the job and increase job satisfaction (Mohrman, 2003; Morgeson & Humphrey, 2006). Knowledge management processes in organisations help workers in knowledge-intensive environments to establish shared understanding and derive value from knowledge (Mohrman et al., 2002). More specifically, knowledge acquisition improves job satisfaction because it involves access to new knowledge that improves efficiency in carrying out one's tasks. Knowledge codification also helps people find the information and informants they need to carry out their tasks in a timely and effective manner. Knowledge-creation processes, on the other hand, enable individuals to participate in planning and designing of activities and to utilise their creativity. Knowledge sharing also relates to social needs of individuals. Knowledge retention increases the sense of recognition and appreciation of the employee, as it is based on recognising the value of the individual's expert knowledge. In sum, the authors suggest that employees will be more satisfied with their jobs to the extent that they experience knowledge management processes in their working environment. This argument can be divided into five more specific hypotheses:

H1. Knowledge acquisition will be positively associated with job satisfaction.

H2. Knowledge sharing will be positively associated with job satisfaction.

H3. Knowledge creation will be positively associated with job satisfaction.

H4. Knowledge codification will be positively associated with job satisfaction.

H5. Knowledge retention will be positively associated with job satisfaction.

The research model is depicted in Figure 1. The paper argues that the five facets of knowledge management – knowledge acquisition, knowledge creation, knowledge sharing, knowledge codification and knowledge retention – improve the likelihood of employee job satisfaction. Job satisfaction, in turn, is related to high performance at both the individual and organisational levels. The rest of this paper concentrates on the relationship between knowledge management and satisfaction. Following the wide range of previous research on the consequences of job satisfaction (Cranny et al., 1992; Judge et al., 2001; Springer, 2001; Shaikh et al., 2012), this paper assumes that there is a connection between satisfaction and performance, although this assumption is not tested empirically.

3 Methods

3.1 Sample and data collection

The research data were collected from employees in a municipal organisation located in south-eastern Slovakia using a Web-based questionnaire. In this public governmental organisation, responses were acquired from 411 respondents, representing the five functional sectors of the organisation: administration; social and health services; education and culture; work, entrepreneurship and business services; and technical and environmental services. The respondents were categorised as follows:

253 (61 per cent) were general employees;

78 (19 per cent) were experts;

47 (12 per cent) were supervisors;

26 (6 per cent) were unit directors; and

7 (2 per cent) belonged to the top management group of the organisation.

With regards to gender, 314 (76.5 per cent) were female and 97 (23.5 per cent) were male.

We present the research model in Fig. 1.

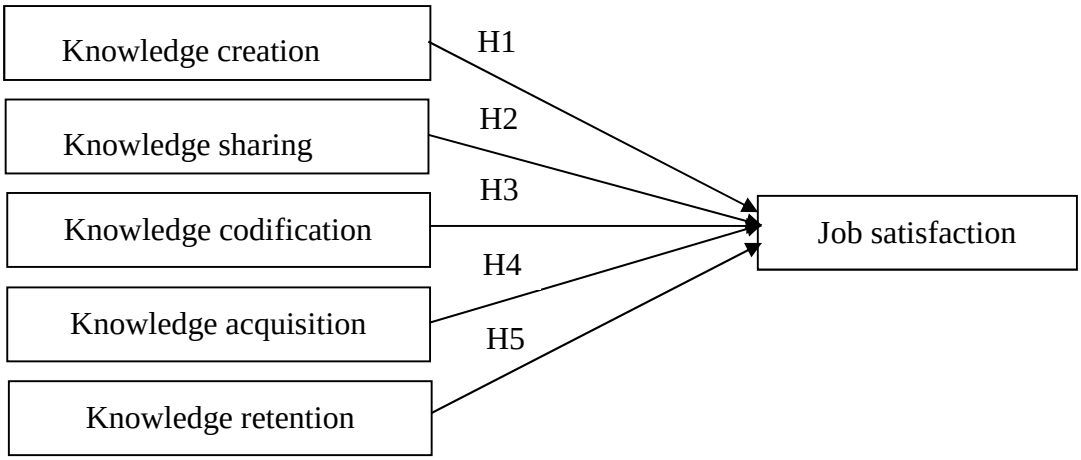

Fig. 1 *The research model*

3.2 Measurement

3.2.1 Knowledge management practices

Knowledge management practices were measured by asking the respondents to answer a set of questions on a scale from 1 to 7 (1 totally disagree, 7 totally agree). The questions were drawn from the Organisational Renewal Capability Inventory survey (Kianto, 2008). The scale for knowledge acquisition examined the importance and fluency of knowledge acquired from extra-organisational sources, whereas the scale for knowledge sharing addressed horizontal knowledge flows inside the organisation. Questions on knowledge creation looked at the frequency and basis of new idea development in different groups of activities. Questions on knowledge codification identified the amount of storage and documentation and the scope of

knowledge repositories. Knowledge retention addressed the continuity and preservation of knowledge within the organisation.

3.2.2 Job satisfaction

To measure job satisfaction, the authors used a three-item composite. Typically, job satisfaction measures focus either on overall satisfaction or on specific facets of satisfaction, e.g. pay, supervision or co-workers (Scarpello & Campbell, 2006). The authors wanted to explore general attitudes towards jobs and, therefore, focused on overall satisfaction. Job satisfaction was measured directly and indirectly, making use of items adopted from Hackman & Oldham (1975).

3.2.3 Control variables

Three variables (respondent's tenure, age and unit) were used as control variables to eliminate the effects they might have had on job satisfaction.

3.3 Assessment of bias

The data relied on self-reported measures and, accordingly, common method variance might have biased the findings. Common method bias is of particular concern when survey respondents are asked to complete items covering both independent and dependent variables. This study used Harman's one-factor test (Podsakoff et al., 2003) to assess the risk of such bias, and the authors conducted a principal component analysis that incorporated all the items from all of the constructs. The study investigated the solution to determine the number of factors required to account for variance in all the items. The largest factor accounted for 36.5 per cent, which suggests that the common method bias was not a concern in this study.

4 Results

We used Partial Least Square (Smart PLS) for the analyses (version 2.0M3 of SmartPLS). The first step was to assess the reliability and validity of the measurement model. The structural model was then used to test the hypotheses.

4.1 Correlation analysis

First, the connections between job satisfaction and knowledge management processes were examined using correlation analysis. Tab. I presents the mean and standard deviations and provides a correlation matrix. The results demonstrate that all knowledge management process variables had significant relation with job satisfaction and with each other. This indicates and supports the study's expectations of interconnectedness between knowledge management processes and job satisfaction.

Tab. 1 *Correlation matrix*

Variable	Mean	SD	1	2	3	4	5
1. Knowledge sharing	4.89	1.09					
2. Knowledge retention	4.19	1.38	0.596**				
3. Knowledge acquisition	4.54	1.36	0.302**	0.276**			
4. Knowledge codification	4.74	1.21	0.432**	0.529**	0.391**		

5. Knowledge creation	3.56	1.15	0.540**	0.672**	0.392**	0.458**	
6. Job satisfaction	4.88	1.30	0.599**	0.487**	0.193**	0.381**	0.391**

Note: **Correlation is significant at the 0.01 level

4.2 Measurement model

To test the measurement model, internal consistency and discriminant validity were assessed.

4.2.1 Control Internal consistency

4.2.1 Construct reliability (CR) and convergent validity measures represent internal consistency. According to the CR test, all the constructs showed a value above the threshold (0.7, as adopted by Bagozzi & Yi, 1988). To test for convergent validity, CR, factor loading and average variance extracted (AVE) were analysed. Loadings of all items were high and statistically significant (Appendix). This means that they were all related to their specific constructs, verifying the suggested relationships between the indicators and constructs. Second, the AVE measure exceeded the cut-off (0.50; Fornell & Larcker, 1981) for all the test constructs.

4.2.2 Discriminant validity

This indicates the extent to which any one construct differs from the others. The AVE should be greater than the variance shared between that construct and the other constructs in the model (i.e. the squared correlation between two constructs) (Fornell & Larcker, 1981). The constructs in this study fulfill this condition: in the model (Tab. 2), the diagonal elements (AVEs) are greater than the off-diagonal elements in the corresponding rows and columns. In sum, the model assessments gave reliable evidence of validity and reliability for the operationalisation of the concepts.

4.3 Testing the research model

As Tab. 3 shows, the research model was able to explain 42 per cent of the variance in job satisfaction. The path model was estimated to reflect the proposed relationships between knowledge management processes and job satisfaction to test the hypotheses. The path estimates from the knowledge management processes to job satisfaction supported most of the hypotheses. The paths from knowledge sharing (H2), knowledge codification (H4) and knowledge retention (H5) to job satisfaction were as hypothesised. Knowledge sharing ($B = 0.439$, $p < 0.005$), knowledge codification ($B = 0.125$, $p < 0.005$) and knowledge retention ($B = 0.193$, $p < 0.005$) each had a significant positive impact on job satisfaction. The research model also predicted direct paths from knowledge acquisition (H_1) and knowledge creation (H_3) to job satisfaction. However, these hypotheses were not supported.

Tab. 2 *Discriminant validity of the research model*

Variable	1	2	3	4	5	6

1. Knowledge sharing	0.58					
2. Knowledge retention	0.36	0.69				
3. Knowledge acquisition	0.09	0.08	0.82			
4. Knowledge codification	0.19	0.28	0.15	0.60		
5. Knowledge creation	0.29	0.45	0.15	0.21	0.52	
6. Job satisfaction	0.36	0.24	0.04	0.15	0.15	0.64

Tab. 3 *Testing the research model*

Path	**Path coefficient**	**t-value**
Tenure → Job satisfaction	- 0.057*	1.966
Age → Job satisfaction	0.142***	4.470
Unit → Job satisfaction	- 0.003 n.s.	0.167
Dependent variable		
Knowledge acquisition → Job satisfaction	- 0. 040 n.s.	1.508
Knowledge sharing → Job satisfaction	0.439***	10.401
Knowledge creation → Job satisfaction	0.014 n.s.	0.501
Knowledge codification → Job satisfaction	0.125***	3.501
Knowledge retention → Job satisfaction	0.193***	3.939
R2		0.420

4.4 Testing models for employee groups

In addition to testing the research model, the authors wanted to explore the relationship between knowledge management processes and job satisfaction in more detail. Thus, additional models were tested for different groups of employees: general employees (N 253), experts (N 78), middle managers (N = 47), unit directors (N = 26) and top management (N = 7). Within the different groups of employees, several highly diversified occupational groups were presented:

- general employees (e.g. cleaners, practice nurses, office secretaries, physiotherapists, caretakers, dental nurses and kitchen helps);
- experts (e.g. development managers, teachers, dentists, vets, nurses and engineers);
- middle managers (e.g. master builders, principals, leading social workers and library directors); and
- top management (e.g. personnel directors, directors of culture and chief administration officers).

As Tab. 4 shows, the models for different employee groups account for between 34 and 58 per cent of job satisfaction. Specifically, knowledge management processes explained the

largest amount of the variance of job satisfaction for middle managers and the smallest amount for top management. Knowledge management processes accounted for nearly 42 per cent of variance for general employees and nearly half of the variance in the expert group. Path estimates from knowledge management processes to job satisfaction show a significant positive relationship between knowledge sharing (B = 0.424, p < 0.005), knowledge codification (B =0.207, p < 0.005), knowledge retention (B = 0.160, p < 0.01) and job satisfaction in the general employee group. For both experts and middle managers, knowledge sharing (experts: B = 0.537, p < 0.005; middle managers: B = 0.504, p < 0.005) and knowledge retention (experts: B = 0.205, p < 0.05; middle managers: B = 0.248, p < 0.01) are related to job satisfaction. For top management, only knowledge retention is related to job satisfaction (B = 0.450, p < 0.01).

Tab. 4 *Testing the research model for employee groups*

Path	**Employees**	**Experts**	**Middle managers**	**Top management**
Control variables				
Tenure → Job satisfaction	- 0.051 n.s.	- 0.071 n.s.	- 0.028 n.s.	- 0.061 n.s.
Age → Job satisfaction	0.149***	0.041 n.s.	0.220***	0.192 n.s.
Unit → Job satisfaction	0.010 n.s.	0.008 n.s.	- 0.011 n.s.	0.039 n.s.
Dependent variable				
Knowledge acquisition → Job satisfaction	- 0.068* n.s.	- 0.075 n.s.	- 0.070	0.096 n.s.
Knowledge sharing → Job satisfaction	0.424***	0.537***	0.504***	0.251 n.s.
Knowledge creation → Job satisfaction	- 0.009 n.s.	0.054 n.s.	0.140 n.s.	- 0.156 n.s.
Knowledge codification → Job satisfaction	0.207***	- 0.011 n.s.	0.049 n.s.	0.096 n.s.
Knowledge retention → Job satisfaction	0.160**	0.205*	0.248**	0.450**
R2	0.419	0.497	0.581	0.340

Notes: ***Significance < 0.005; **significance < 0.01; *significance < 0.05

5 Discussion

Of the five knowledge management processes examined in this study, only two had no connection to job satisfaction. Based on this study, therefore, it seems that knowledge acquisition and knowledge creation are not factors that affect job satisfaction. This might be because of the context of the study. It is possible that the nature of the work carried out in this municipal organisation requires neither knowledge acquisition (especially from sources or partners outside the organisation) nor creation of new knowledge. Such activities are not encouraged by either support or reward in the organisation. Consequently, they have no effect

on job satisfaction. However, the remaining three knowledge management processes (knowledge sharing, codification and retention) had connections with job satisfaction. Specifically, the results indicate that intra-organisational knowledge sharing is the key knowledge management process, promoting job satisfaction for most employee groups. Knowledge-sharing mechanisms are probably the most intensively studied facet of knowledge management, which seems to be well justified also from the perspective of well-being at work. Collegial support and encouragement, and a positive work climate, seem to be strong enablers of job satisfaction – as well as high job performance. The results also demonstrate that the significant knowledge-based promoters of job satisfaction differ as a function of job characteristic. Specifically, knowledge management processes account for 58 per cent of the variance of job satisfaction for middle managers, the largest percentage in the study. For this group, knowledge sharing was the key issue, followed by knowledge retention. Judging by the large amount of variance in job satisfaction accounted for by knowledge management issues, it appears that knowledge management is especially important in ensuring positive attitudes towards work for middle managers. This is understandable because their work mostly relates to coordinating activities between different resources within the organisation (Nonaka and Takeuchi, 1995). The second largest variance explained was for the experts. For this group, knowledge management processes accounted for almost half of the variance in job satisfaction. In addition, internal knowledge sharing and knowledge retention were the key processes that improved job satisfaction. As problem solving is a central characteristic of experts' work, it could be argued that experts find satisfaction in being able to share the solutions they have produced with others and in seeing how they impact organisational functioning. Although knowledge acquisition, creation and codification also play an important part in experts' work, they do not increase their job satisfaction, according to the results of this study. Job satisfaction for the general employee group was also significantly influenced by knowledge management processes, specifically, knowledge sharing, knowledge codification and knowledge retention. This means that the widest range of knowledge management processes affects job satisfaction for general employees. This is to be expected as tasks for this group are the most divergent. Interestingly, this group does not appear to view external knowledge flows in a favourable light: knowledge acquisition had a small negative impact on job satisfaction. In the strictly guided and routine tasks of the general municipality employee, knowledge acquisition may be seen as a hindrance, which could distract the employee from task performance. Knowledge management processes seem to have the least impact on job satisfaction for the top management of the municipal organisation. This is a somewhat surprising finding as the work of high-level managers is all about knowledge work, handling complex issues and problem solving. It could, therefore, be assumed that they would particularly benefit from efficient knowledge flows. Knowledge retention was the key knowledge management process for this group, meaning that knowledge continuity and preservation are important for ensuring their work satisfaction. This is to be expected as the strategic steering of an organisation requires an extensive and deep understanding of its history to construct path-dependent strategies. It is also important for this group to understand external forces and the institutional and legislative environment in which the organisation operates. Interestingly, intra-organisational knowledge sharing, which is the key factor for other occupational groups, does not seem to be an important knowledge management process for top management job satisfaction. Perhaps the reference group of top management is located outside the organisation; as a result, the collaborative climate of intra-organisational knowledge sharing may not be particularly relevant for this group.

6 Conclusion

While the impact of knowledge management has typically been studied in terms of the benefit it brings to organisational-level performance, very few previous studies have examined the impact of knowledge management on "soft" human issues from the perspective of individual employees. This study provides knowledge on a type of consequence of knowledge management - job satisfaction - which has been largely unexplored in previous research. The key finding is that existence of knowledge management processes in the working environment is linked to high job satisfaction. Consequently, this study demonstrates a novel benefit of knowledge management for organisations, strengthening the argument that knowledge management is an important driver of value creation, organisational competitiveness and success (Carneiro, 2000; Bhatt, 2001; Zack et al., 2009; Andreeva & Kianto, 2012). Overall, this demonstrates knowledge management as a novel organizational practice, which promotes job satisfaction. Thus, knowledge management can be added to the toolbox of managers, consultants and other organisational developers attempting to improve the conditions for well-being at work.

6.1 Implications for practitioners and researchers

The results of this study illustrate that knowledge management has a strong impact on employee job satisfaction. It should, therefore, encourage managers to implement Implications for practitioners and researchers activities in their organisations, to improve both knowledge worker performance and well-being at work. In addition, the results demonstrate that different employee groups benefit from different kinds of knowledge management activities. The paper, therefore, provides guidelines for a targeted implementation of knowledge management in different intra-organisational working environments. By demonstrating that the benefits of knowledge management differ as a function of employee group, the paper supports moving knowledge management research to the next stage, where the impact of knowledge management practices can be explored not as a "one size fits all" phenomenon but rather as a contingent and contextual issue, taking into account the requirements and characteristics of the various types of tasks conducted in an organisation.

6.2 Limitations and future research

It should be noted that as the study design was cross-sectional, it is only possible to hypothesise the direction of the impact between knowledge management processes and job satisfaction. It could be argued that those employees who feel satisfied with their jobs are more likely to engage in knowledge activities than those who do not feel so positively about their work. Ascertaining the direction of impact would require a longitudinal research setting. Another limitation of the study relates to the lack of an empirical analysis of work performance. Although it does not empirically address this question, this study makes the assumption that job satisfaction ultimately leads to high performance, based on the extensive empirical research available on this topic (Cranny et al., 1992; Judge et al., 2001; Springer, 2001; Shaikh et al., 2012; Quedraogo & Leclerc, 2013). Although this link does not seem to need further justification, it should be noted that, to the authors' knowledge, no previous study has addressed the impact of job satisfaction on knowledge worker performance. Examining the links between knowledge management processes, job satisfaction and knowledge work performance could be an interesting topic for future research. Finally, this study is among the first to examine the relationship between knowledge management and job satisfaction. As such, it has only provided an initial perspective on the topic, and much more research remains to be done to deepen its

understanding. Potential fruitful avenues for future research include looking at knowledge types as contingency variables. Adding closely related issues to the research model, such as organisational commitment and work engagement, could also prove valuable.

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Problems of Knowledge Transfer in the Field of Taxation

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Abstract: The purpose of the paper is to reduce the gap in the literature on taxation, where problems of knowledge management, knowledge transfer and knowledge sharing are scarcely analyzed. In the author's opinion, the basic reason behind this situation is the fact that interrelations between the main players in the field (tax authorities, tax payers, national governments, etc.) are based more on rivalry than on cooperation. It's believed that benefits of some players can be achieved just to

the detriment of others. Moreover, there is no institution that could be responsible for knowledge management and transfer in this field. Three levels of knowledge transfer in the taxation will be analyzed: inter-governmental knowledge sharing - learning from other countries' experience in fiscal policy; vertical communication channels within individual countries´ fiscal policy; horizontal knowledge transfer between business units (and inside business units), including the role of consulting companies.

Keywords: up Tax system; role of knowledge in taxation; knowledge transfer and knowledge sharing in the field of taxation; inter-governmental knowledge sharing; vertical and horizontal communication channels. semicolon.

1 Introduction

Tax systems design, administration and tax compliance at all levels are certainly knowledge demanding activities. However, knowledge management issues and knowledge transfer in the mentioned area (especially tacit knowledge sharing) are scarcely analyzed in the literature and are not sufficiently supported by official tax policies. Taxation – which is very important for governments, sub-central fiscal authorities, businesses and all citizens – is a complex reality in search of a supporting knowledge management theory.

In the author's opinion, the basic reason behind this situation is the fact that the interrelations between the main players in the field of taxation (national tax authorities, subnational fiscal bodies, tax payers, etc.) are based more on rivalry than on cooperation. It's widely believed that increasing benefits to one group of players can be achieved just at the detriment of others. Trust, which is a precondition of effective knowledge sharing, (especially tacit knowledge sharing) is often missing. Moreover, there is no institution that will be motivated and empowered to take the role of a knowledge manager in the global taxation framework. Supranational authorities (e.g. OECD or EU) try to achieve some coordination and support knowledge transfer between countries on taxation issues. However, without national governments' motivation and support, their vision of fiscal harmonization seems unrealistic.

In the following parts (subchapters) of the paper, three levels of knowledge transfer in the field of taxation will be analyzed and commented on:

a) Inter-governmental exchange of information (between tax authorities of different countries), with a special role of the EU authorities in the field;

b) Vertical communication channels within individual countries (between tax authorities and tax payers), including communication channels under the fiscal decentralization scheme. Also, the importance of bottom-up knowledge flow will be emphasized;

c) Horizontal communication channels between organizations (businesses, consulting companies providing services in the field of taxation) and intra-organizational flow of knowledge (e.g. between tax specialists in the company and other departments).

2 Inter-governmental knowledge transfer in the area of tax policy

Basic "units" in the world of taxation are individual countries' (national) tax systems. Governments regard independent fiscal policy as the key element of their economic sovereignty and are not willing to accept limitations of this right. However, in the world of increasing interdependence of individual countries and economic agents (tax payers) and intensifying digitalization, which rapidly increases the speed and technical possibilities of knowledge transfer, absolutely independent fiscal policy (and tax policy as its part) is an illusion. This is especially true for the European Union.

The current EU taxation framework leaves Member States free to decide on their tax systems provided they comply with European Union (EU) rules. Those rules are adopted unanimously by the Council. The development of EU tax provisions is linked with completion and proper functioning of the single market, with indirect taxes addressed earlier and more in-depth than direct taxes.

National tax systems face stronger competition as a result of the globalization of the economy. Tax competition favors certain taxpayers to the detriment of others, and the same holds true for Member States when they compete in taxation to attract investors. This is a barrier not only to proper functioning of the single market in the EU but often also to effectiveness of countries' own fiscal policies (harmful tax competition, corporate profit shifting to countries with more liberate tax systems, unregulated transfer pricing policy by TNCs, etc.). Globalization and digitalization both trigger a need to update and adapt tax systems. They offer the opportunity to modernize tax systems generally considered as complex and consequently having a side effect of creating undesirable potential for tax avoidance and evasion (European Parliament, 2015).

Taking-up this challenge requires more intensive and broader knowledge sharing between countries, especially between EU member states. A lot of data on individual countries' tax systems, tax revenues and tax structure in the EU as a whole are officially published. Tax databases are formed also at the OECD level (OECD 2017). This explicit knowledge is available to all players in the world of taxation and can be used by governments to optimize their tax policies. It is difficult to estimate how much of this information is actually used and how much countries actually learn from other countries' experience.

Tax policy is at a crossroads: it remains a national matter but requires increasing cooperation and coordination at EU and international level to address specific issues and challenges. It seems that although, for a long time, national governments have been against more strict tax harmonization proposals, recently they are more willing to cooperate to combat tax evasion and tax fraud.

OECD has done a lot of work not only in defining and analyzing aggressive tax planning practices. It has detected a lot of aggressive tax planning techniques applied by internationally active companies and published a directory of over 400 aggressive tax planning schemes submitted by member countries. This is just one of the important materials available to governments, a source of knowledge that has become explicit on the basis of processing tacit knowledge collected from individual countries that were willing to cooperate. OECD has published a lot of reports and materials explaining why reforms in taxing multinational enterprises are important for all countries; it suggests measures to close gaps in international tax rules that allow multinational enterprises to legally but artificially shift profits to low or no-tax jurisdictions (e.g. BEPS - base erosion and the profit shifting initiative). OECD also initiates and supports multilateral conventions and forums for knowledge transfer between governments - e.g. a document *Multilateral Convention to Implement Tax Treaty Related Measures to Prevent BEPS*, which was signed on June 7, 2017 by over 70 Ministers and other high-level representatives (OECD 2017). A lot of interesting data and suggested measures have been published also on transfer pricing policy, which is an important form of profit shifting and tax base manipulations (PKF 2017).

From the knowledge management point of view, these materials represent a huge complex of data that can be analyzed by appropriate KM techniques, and individual countries can determine what correlations and trends are of key importance and topical for their tax policy plans. Intensive knowledge transfer between countries and in-depth research performed by experts from the OECD Centre for Tax Policy and Administration have been the background of these publications.

Experience from the recent years shows that intergovernmental knowledge transfer (and knowledge sharing between official statistical institutions of different countries) can work effectively *if the governments are interested in the cooperation*, and it works in the sphere where they trust each other (or at least regard the exchange of information as mutually beneficial). All governments, in principle, are motivated to reduce tax avoidance and fraud, to improve the mechanism of collecting taxes.

However, the need of knowledge transfer between countries (connected with taxing issues) is important also in other areas where it is difficult to achieve a consensus. Knowledge flow is very important for the whole complex of the so-called *tax spillovers issues*, meant as the impact of one country´s international tax policy on other countries. Potential economic implications of international tax spillovers thus go well beyond tax revenue, with wider implications for the broader level and distribution of welfare across nations (IMF, 2014).

Published data on taxation are explicit knowledge, available to anybody who is interested. However, a lot of tacit knowledge is still behind the published figures. This is especially important for corporate income taxes. Tax rates are known, but the details of forming the tax base, treating intra-corporate debt, forms of transfer pricing policy especially in intangibles and intellectual assets (that are difficult to objectively measure), amounts of provided and planned tax allowances as the form of government aid to investors, etc. are not known. These forms of tax rules (direct and indirect) can play an important role in the tax competition between countries. However, in principle, governments are not willing to share the knowledge in this field.

In the practice of fiscal policy, it is usually assumed that sharing additional knowledge about taxation issues would be at least a zero-sum game, where the knowledge receiver (seeker) will gain at the detriment of the knowledge provider (source), and the additional information can be

misused. However, unwillingness to share information may lead to losses at both sides, and, on the other hand, knowledge sharing can be mutually beneficial. Knowledge sharing (including tacit knowledge sharing) can help to improve the mechanism of collecting taxes, better monitor the transfer pricing policy of companies, adjust rules of forming the tax base in a way that will be advantageous also for local companies (improving business environment), forecast impact of planned changes in the tax rules, etc.

Governments will probably never accept the full harmonization of tax systems. Even if the formal rules are the same, there will still be differences in practical approaches. However, a lot can be done in deepening and widening the mutual communication and knowledge transfer. International institutions and researchers can significantly contribute not only to conversion of so far tacit knowledge into explicit knowledge (by publishing additional data based on individual countries´ experience) but also to creating new tacit knowledge, e.g. by improving methodology of research, etc.

3 Vertical knowledge transfer between tax authorities and tax payers

In individual countries´ tax systems, the basic form of knowledge transfer is top-down communication between the tax authority (central through lower levels bodies) to tax payers. Sometimes, this is the only way of communication with a significantly authoritarian approach. The central authority publishes legal norms and interprets them, which is also important because of frequent changes in the legislation. Feedback from lower levels (bottom-up flow of information) is scarcely used. Lower level players in the tax system are just supposed to comply. In some cases, tax payers´ requirements and comments can be interpreted by particular bodies (e.g. employers´ associations) and negotiated with the government. Sometimes, the formal representation is missing (small businesses, citizens), or some official communication exists, but cannot be regarded as knowledge flow between equal partners (e.g. knowledge transfer in the framework of the fiscal decentralization – IMF, 2017).

Top-down knowledge transfer within individual tax systems cannot be regarded just as explaining taxation rules and requirements. It should perform also an educational function. Central tax authorities should explain to lower level and decentralized authorities the rationale for tax changes, details of compliance requirements, which can include some tacit knowledge. The lack of this communication can lead to problems in the working of tax systems – as the case of Slovakia shows (Jakubek et al., 2016). On the other hand, some bottom-up knowledge transfer, as feedback helping to improve the tax legislation, is also very important. In some countries, a *lack of IT skills* of particular groups of tax payers can also be a barrier.

Tax authorities sometimes require a digital form of reporting and communication, which presents a serious problem for some small businesses. Improving IT skills of the population (especially those that are not included in the formal education) is an important educational role of the government, relevant not only in the field of tax policy but also in other forms of policy. e-government projects can´t properly function without this education.

There are many unsolved problems in vertical communication flow within tax systems, and further research could significantly contribute to mapping these problems and suggesting potential solutions. Organizations that possess a lot of important explicit and tacit knowledge in the field are *consulting companies* providing services in the area of accounting and taxation. Although their primary function is cooperation with business organizations (mainly large companies), they publish and disseminate a lot of knowledge that is important also for the

national economy as a whole (Erst & Young 2011; PKF, 2017, etc.). Unfortunately, this knowledge is hardly used in the government´s economic policy.

4 Horizontal (intra-organizational and inter-organizational) knowledge transfer in the field of taxation

The bulk of the literature on knowledge flows and knowledge management regarding taxation deals with these issues at the level of corporations. This is quite natural. Taxes that companies should pay can influence a firm's operating and financial decisions not only by direct imposition of the tax itself but also indirectly through associated compliance costs. Firms can attempt to reduce the impact of taxation, both through tax planning and by ensuring that compliance-related tasks are carried out efficiently (Haseldine et al. 2009, p.7).

An interesting theoretical approach to the mentioned issues is the concept of the so-called *market for tax knowledge*. Basic participants in the tax system are regarded as market players. Processes by which taxpayers become aware of tax legislation and other tax-related information are called *tax knowledge* (Haseldine et. al., p.7-11). A tax authority is the producer and seller of this knowledge. Tax payers, basically companies, are the buyers of tax knowledge. Consulting companies providing services in the field of accounting and taxation are brokers that intermediate the transactions. At various stages, the parties' roles may change; for example, in some settings, corporate taxpayers may act as knowledge suppliers to accountancy firms acting as knowledge buyers. The central tax authority can also be a "buyer" of tax knowledge (in its role of determining whether taxpayers have complied with legislation and when it is looking for feedback from the tax system participants in the assessment of the existing and proposed legislation and administrative processes).

This model is very interesting and inspiring. Although the market in this model does not correspond, in many aspects, to the traditional working of competitive markets (just the relations between consulting companies and corporations are actual market relations), it makes it possible to include and analyze motivation, tactics and strategy of basic participants in a tax system. Primarily, the model is oriented towards inter-organizational relations and knowledge transfer, but it is possible to apply it also at the intra-organizational level (e.g. knowledge sharing between tax experts and nonfinancial operational decision makers in a company). An advantage of this model is also the fact that it makes it possible to include all types of tax knowledge buyers, not just transnational companies and their tax planning policies (as mentioned in the first part of our paper).

The application of the market for tax knowledge model in research performed in the U.K. has led to conclusions that are in principle relevant also to tax systems in other countries, including Slovakia (compare Jakubek et. al., 2016).

Companies included in the survey (together 218 respondents) mention official documents of the central tax authority (websites, newsletters, etc.) as the basic source of tax knowledge. Direct communication with tax authorities is regarded as weak, and if some knowledge sharing with tax authorities occurs, it is motivated basically by attempts to achieve financial or reputational benefits (about 10-11 % of respondents). It can be assumed that this motivation is typical basically for large companies. Maybe the understanding of tax rules is better in

developed market economies (in comparison with Slovakia or other new EU member states). Consulting firms are significantly helping in practical application of the tax knowledge.

However, a tax authority can be regarded as a heterogeneous complex, including lower level officials and decentralized decision makers in the framework of fiscal decentralization (Jakubek et a. 2016, IMF 2017), and officials at these levels may negatively evaluate the role of the central tax authority in knowledge sharing. These issues are not addressed in the U.K. survey.

The role of consulting companies as tax advisers has not been sufficiently analyzed in European literature. The U.K. research brings some interesting findings in this area. More than 90 % of respondents agree or strongly agree that tax advisers are an important source of tax knowledge for their organization. It is interesting that the importance of cooperation with external tax advisers varies, in some regard, in the internal tax knowledge management system in the company. If the company has got some internal tax specialists, its dependence on external advisers is lower, and lower is also the willingness to share some internal accounting and tax information with external parties.

In all countries´ tax systems, top-down knowledge transfer from the tax authority to consulting companies (tax advisers) is important. Consulting companies must respect the law and advise in such a way that clients´ decisions comply with the law. However, an interesting finding of the U.K. research is that also a tax authority regards the knowledge transfer from consulting companies (bottom-up) as useful and takes it into account in forming a tax policy. This lesson can be learnt by many countries.

In the *intra-company tax knowledge management systems*, it is important to consider the degree of interaction between taxation and operational decision making within a company. According to majority of respondents, tax awareness of non-financial decision makers is poor. This is probably true for many countries. According to the U.K. survey, it is disappointing that just one third of operating managers seek knowledge from internal taxation experts although they (operating managers) are evaluated on the basis of criteria reflecting taxation (revenue after taxes, etc.). On the other hand, the influence of internal tax experts on operating decision making is not significant either. It seems that internal tax knowledge flows do not work appropriately.

From the knowledge management point of view, capturing internally generated tax knowledge is an important role of the tax function. However, only minority of companies have either formal (30.5 %) or informal (48.8 %) procedures designed to capture this knowledge. One of the basic conclusions of the U.K. research is that "Corporate taxpayers should consider their need for tax knowledge management in the wider context of decision making in general" (Haseldine et al. 2009, p.29).

At the level of multinational corporations and their tax planning, a neglected topic of knowledge management and tax knowledge management literature is *the transfer pricing knowledge management system* (Plesner Rosing – Pearson, 2014). Although the transfer pricing policy has been intensively addressed in materials published by international organizations and discussed in the public policy, a theoretical analysis of the activities that a multinational enterprise (MNE) performs in order to create, organize and transfer knowledge for meeting transfer pricing objectives is missing. Such theory could actually contribute to improving the interrelation between taxation and operating decisions of a company.

The aim of the transfer pricing knowledge management is to ensure that knowledge of the historical and future transfer pricing practices of the MNE is captured, organized and transferred

in a transparent and logical manner to those who need it, when they need it. Basically, knowledge captured in these systems is explicit knowledge structured for potential users (including external tax inspectors). MNEs usually give high priority to the ability to demon¬strate that their transfer pricing positions are set and doc¬umented in compliance with the local tax laws and transfer pricing practices are accepted by local tax authori¬ties. Tacit knowledge, which is also important in transfer pricing policy, is more difficult to formulate, and companies are often unwilling to make it accessible to external users.

The transfer pricing database of a company is based on internal accounting information but includes also many types of transfer pricing-related material that go beyond the core accounting data, such as: inputs from operational staff during functional analyses; stra-tegic/operational business documents; intercompany invoices; experience from transfer pricing audits and lit¬igation; learning from external transfer pricing network meetings and conferences; conclusions from meetings with tax authorities and external advisers, etc. Experience of MNE employees at both the central and decentralized organizational levels is also an important source of knowledge. Even MNE employees, besides those directly involved in transfer pricing activities, such as business operational staff, will – over time – generate knowledge that adds to the MNE transfer pricing knowledge base.

The literature on transfer pricing has been growing rapidly during the recent years. This trend is not just a response to increasing globalization and intensive competition. This is also a result of a "race" between two groups of knowledge seekers in the field : regulators (national, but mainly supranational bodies), which try to map and identify the recent techniques of transfer pricing used by MNEs and formulate rules, or at least recommendations, for national governments to monitor this policy and adjust national tax regulation and, on the other hand, MNEs, which have to improve their transfer pricing policy to meet new challenges and simultaneously are confronted with more sophisticated regulators and tax inspectors that are able to discover some deeper and confidential background of a transfer pricing policy. MNEs also have to respond to new demands of regulators and innovate methods of their transfer pricing policy. Of course, tax knowledge of regulators is different in different countries and must be of an interdisciplinary character (to better understand also technological aspects of MNEs' activities and their value chains).

5 Conclusion

Literature on taxation, both at the theoretical level and in practical policy, is very rich. However, problems of transferring knowledge, and especially tacit knowledge sharing, have been addressed scarcely. The process of globalization and digitalization has provoked more interest in the knowledge transfer in this field because of the need to somewhat regulate multinational companies´ policies in the field of profit shifting and tax base manipulation. Inter-governmental knowledge transfer in this area is supported by international institutions (OECD, IMF, EU). However, many governments are not willing to cooperate or do not use sufficiently available databases.

Vertical knowledge transfer from the top (central tax authorities) to the lower levels (tax payers) has traditionally been the basic knowledge flow in individual tax systems. The more digitalization is applied to the tax policy, with increasing complexity of tax rules, the more of the educational function of the tax communication comes to the fore. Central authorities have

to explain new tax compliance requirements and help improve IT knowledge of some taxpayers. Bottom-up knowledge transfer (feedback from taxpayers) is also important.

The most developed problem area in the literature on tax knowledge management is the horizontal communication within business organizations (e.g. between tax specialists and other managers), which is supposed to contribute to optimization of tax burden and improving methods of tax compliance. In the horizontal communication between organizations, the role of consulting companies is important..

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Innovation and Productivity on Industrial Level

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Vysoká škola manažmentu v Trenčíne

International Workshop on Knowledge Management IWKM‘2017

Trenčín 12 - 13. 10. 2017

Innovation and labor productivity

- Innovation
- Labor productivity
- GDP

Studies and Research

- Empirical studies
- 50s
- 90s – total sales
- 2000s – value added
- New models, approaches

Goal

- Comparison
- Various industries same impact?

Method

- Granger causality
- causality as a symmetrical relationship
- difficult to decide about the direction of causality between variable x and variable y
  - how much of the current variable can be explained by the past values and
  - whether lagging the variables by several periods of time improves this explanation.
  - whether variable x could be useful in predicting variable y
- Null hypothesis: x does not Granger cause y and y does not Granger cause x

Model

- Eurostat
- 28 European countries
- 13 main industries
- 16 years: 2000-2016
- **Innovation**
- Investment in R&D as % of GDP
- Investment in R&D as % of industry Value Added
- **Productivity**
- Industrial Value added per person employed

Results - Investment in R&D as % of GDP

Industry	Inv in R&D as % of GDP causes VA p.p.	Value added p.p. causes Inv in R&D as % of GDP
Construction	yes	yes
Electricity, Gas	yes	yes
Financial	yes	yes
Manufacturing	yes	yes
Mining	yes	yes
Scientific Activities	yes	yes
Transportation	yes	yes

Results - Investment in R&D as % of GDP

Industry	Inv in R&D as % of GDP causes VA p.p.	Value added p.p. causes Inv in R&D as % of GDP
Education	no	yes
ICT	no	yes
Water supply	no	yes
Wholesale, Retail	no	yes

Industry	Inv in R&D as % of GDP causes VA p.p.	Value added p.p. causes Inv in R&D as % of GDP
Accomodation	yes	no

Results – R&D/VA p.p.

Industry	R&D/VA causes VA	VA causes R&D/VA
Construction	yes	yes
Electricity, Gas	yes	yes
Financial	yes	yes
Manufacturing	yes	yes
Mining	yes	yes
Scientific Activities	yes	yes
Transportation	yes	yes

Results – R&D/VA p.p.

Industry	R&D/VA causes VA p.p.	VA p.p. causes R&D/VA
Accommodation	yes	no
Agriculture	yes	no

Industry	R&D/VA causes VA p.p.	VA p.p. causes R&D/VA
Water supply	no	yes
Wholesale, retail	no	yes

Industry	R&D/VA causes VA p.p.	VA p.p. causes R&D/VA
ICT	no	no

Summary

- European model – 7 out of 13 industries bidirectional

Discussion

- International comparability of data
- Regulation and policies for taxation of innovation, tax credits
- Better reporting

- More detailed data – individual companies

Resources

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Run of the seminar (S1)

Data Mining Tools and Computer Aided Quality

At the beginning of the seminar "*Data mining tools and computer-aided quality*", not only software systems for data and process processes (**WEKA, RapiMiner, Minit, ...**), but also **MES** (*Manufacturing Execution Systems***) Wonderware** were introduced. All of these systems support the collection and subsequent analysis of business data, while **quality managers** are needed , especially in the area of **poor quality forecasting**.

Many speakers addressed the theme of **Industry 4.0**. This modern concept of production, which consists of four basic principles of organizational organization: **"networking", transparency of information, technical support and decentralization of decision-making**, requires the preparation of not only technically capable graduates, but especially graduates for middle and top management who will be in charge of this concept. The current labor market needs knowledge workers with both explicit and tacit knowledge.

Almost every business or organization already **needs a knowledge manager** (sometimes called a **digital / data steward**) who can manage knowledge workers, understand the business informatics processes, analyze a huge amount of data (big data) that arise in business processes and knows to gain knowledge that promotes the competitiveness of the company.

Renata Janošcová

Co-chair

Using Rapid Miner in Computer Aided Quality

Petr Berka
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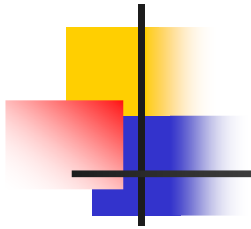
University of Economics
Prague

Seminar on Data mining tools and CAQ (S1)

Vysoká škola manažmentu v Trenčíne, International Workshop on Knowledge Management, IWKM'2017

Trenčín 12 - 13. 10. 2017



Computer Aided Quality as a Data Mining Problem

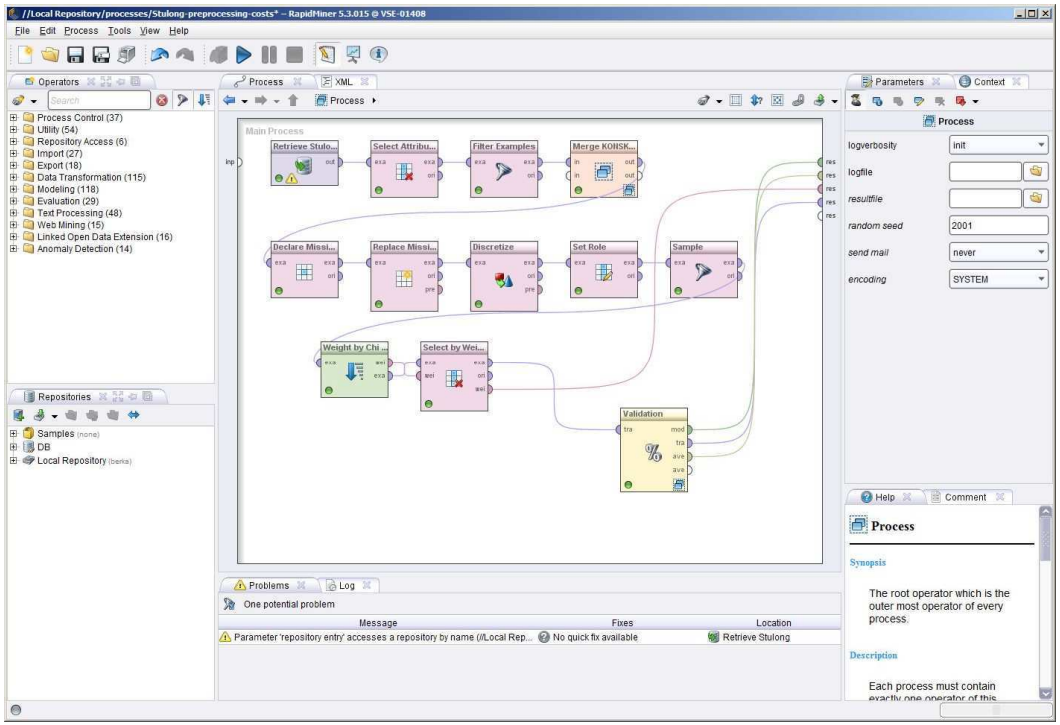
Based on measured characteristics of a product decide if the product is Risky or not

From data mining point-of-view:

- Binary classification task
- All input attributes are numerical

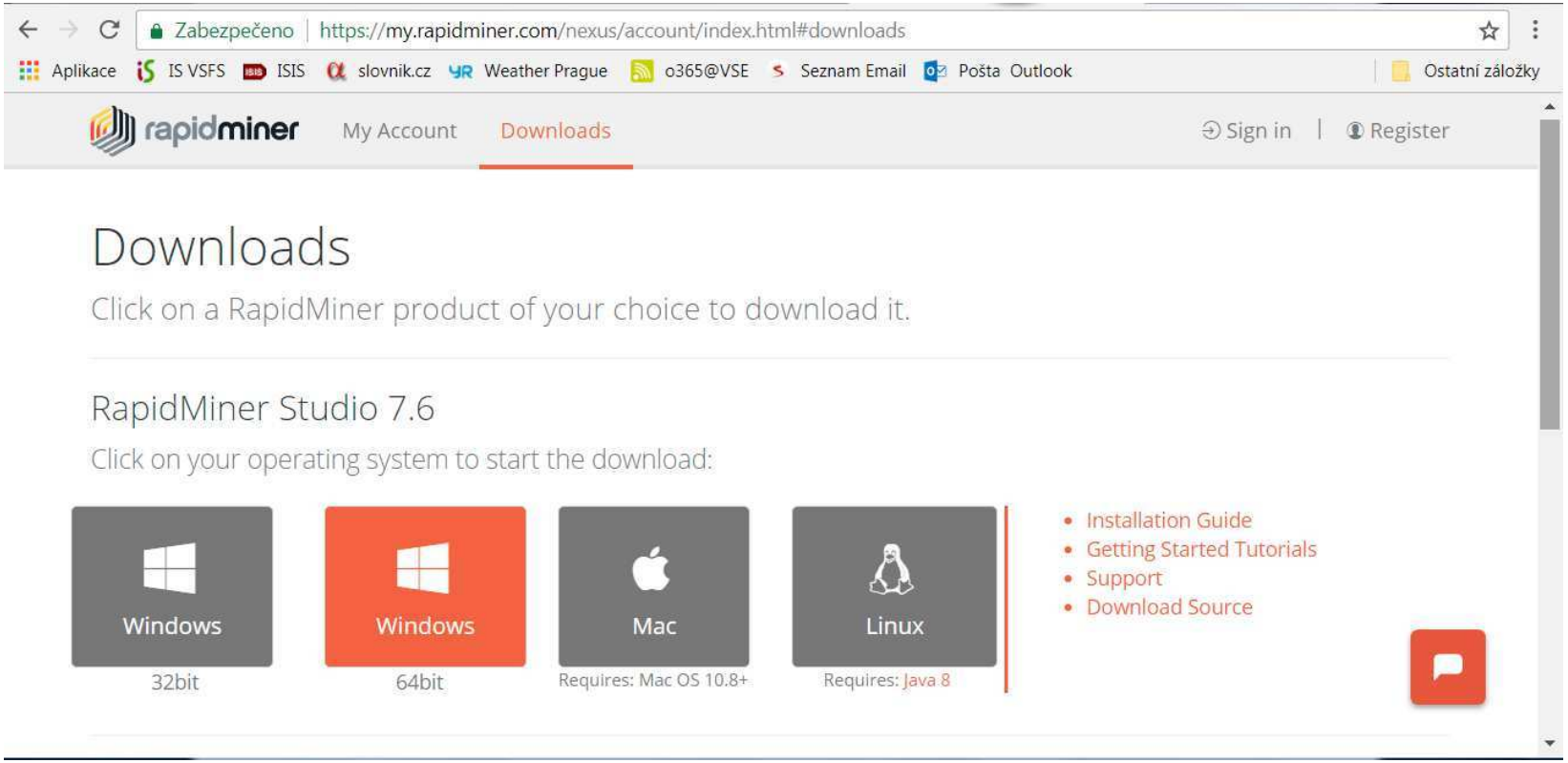
Rapid Miner (rapidminer.com)

- a leading open-source system for knowledge discovery and data mining (www.kdnuggets.com)
- a Leader in 2016 Gartner Magic Quadrant for Advanced Analytics (www.gartner.com)
- the Top 3 Rated Predictive Analytics Software for Enterprise (www.g2crowd.com)

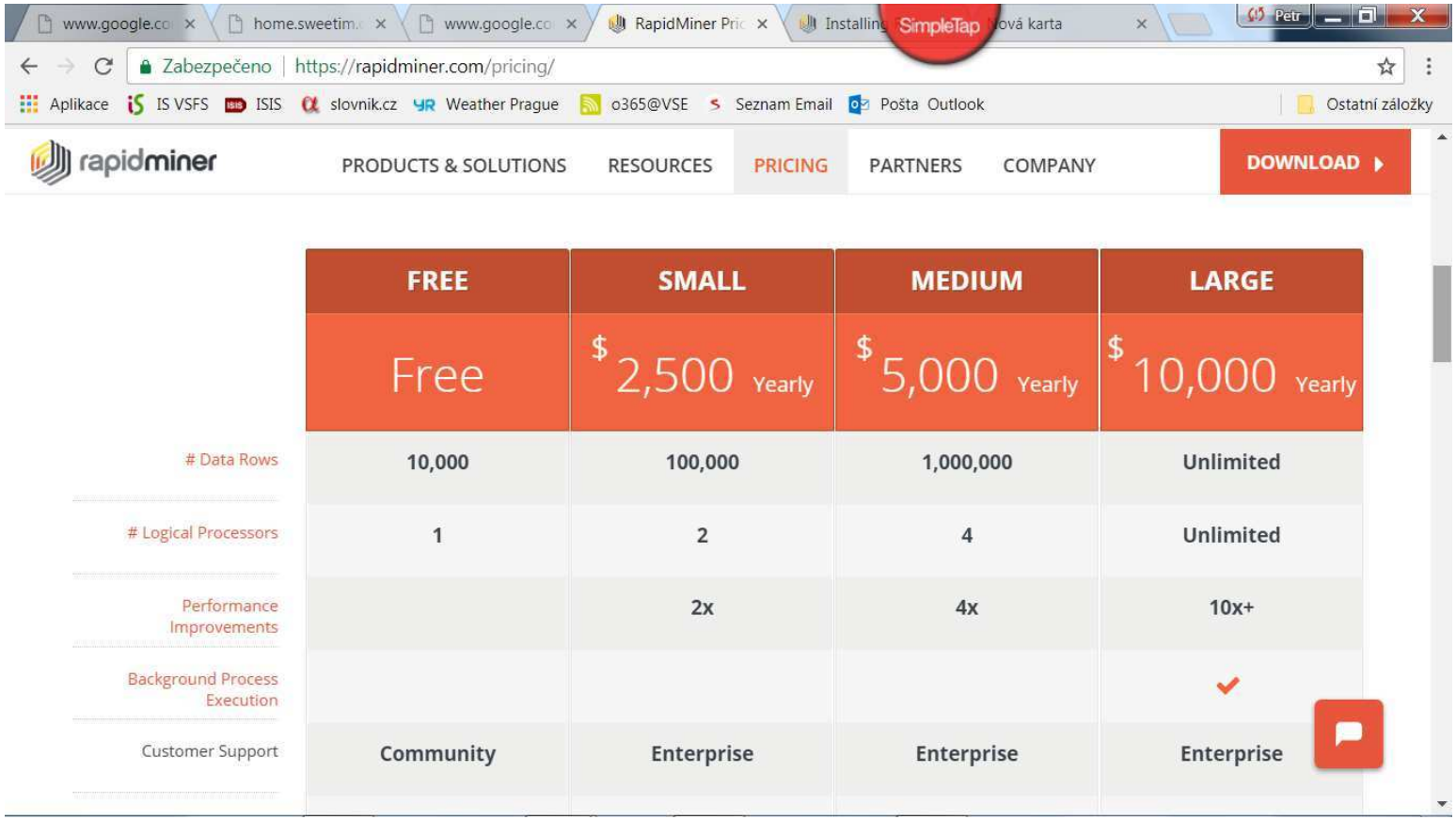


Rapid Miner Downloads

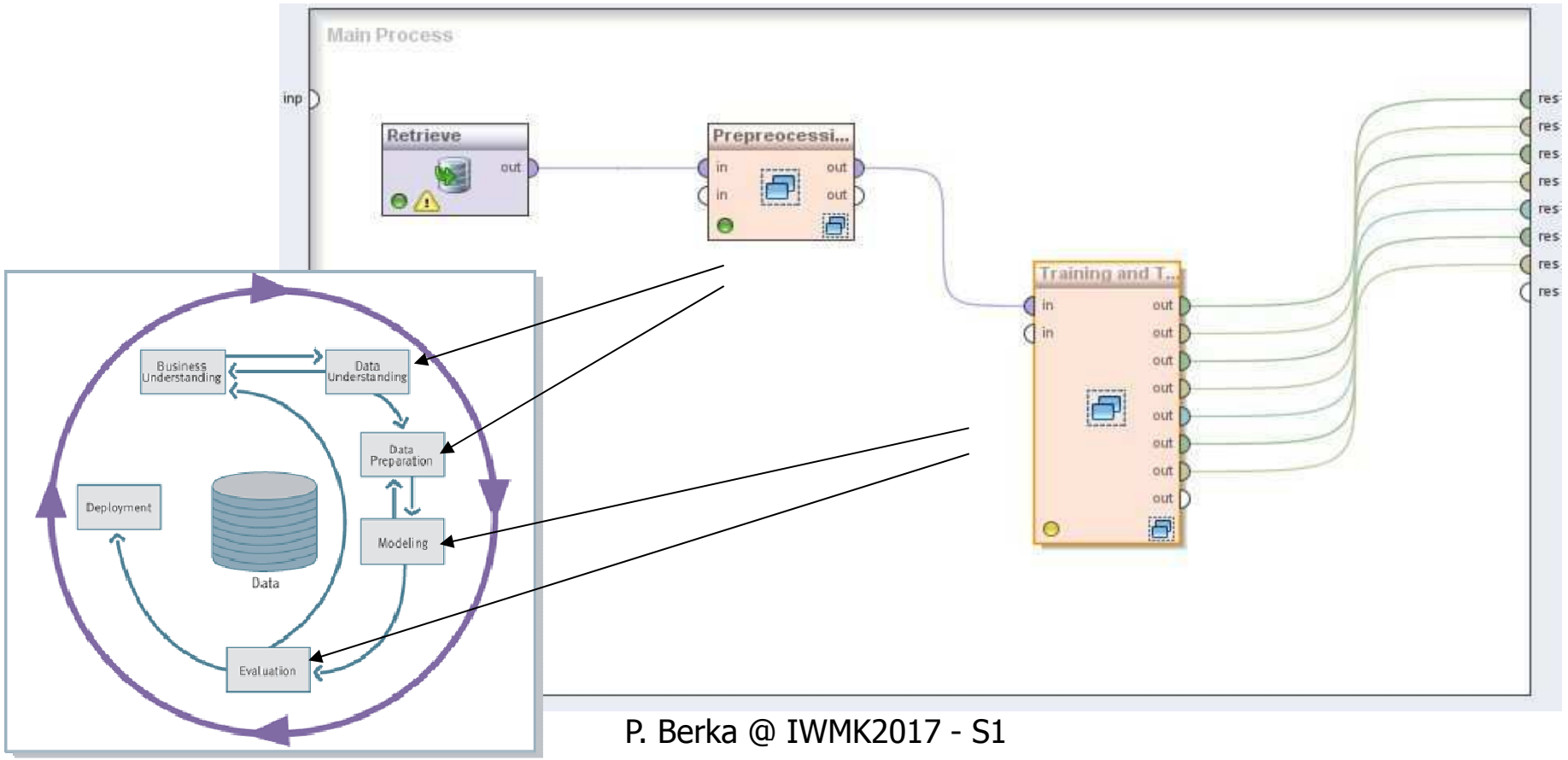
https://my.rapidminer.com/nexus/account/index.html#downloads



Rapid Miner Pricing



Overview of a DM Project



Retrieve original data

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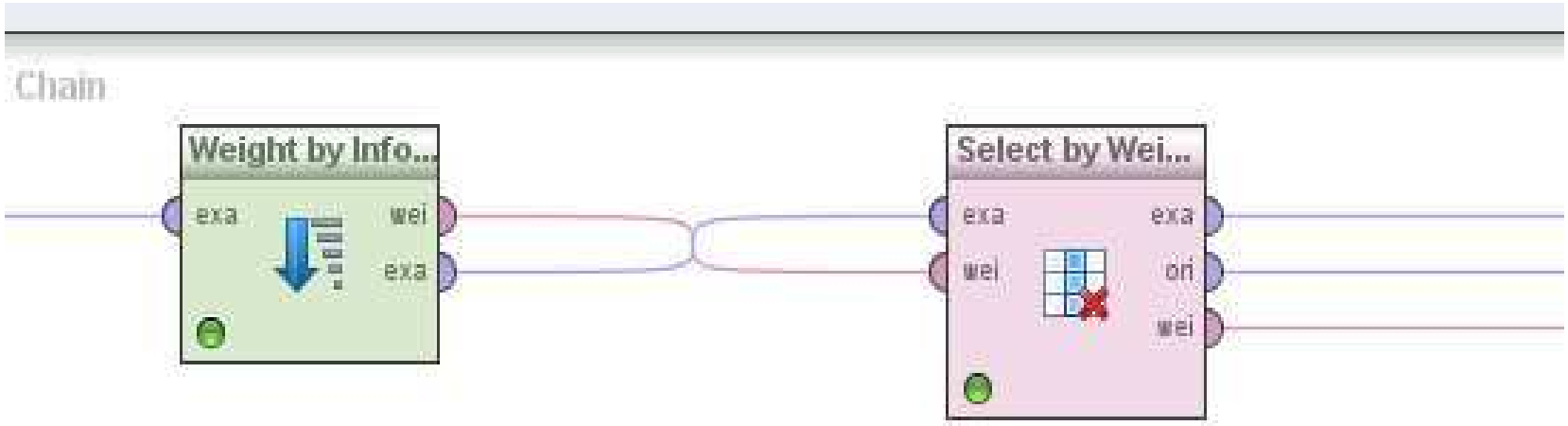
2	OK	351.100	0.080	4049	0.256	0.257	0.622	0.275	0.267	0.547	0.135
3	OK	382.400	0.070	4774.100	0.262	0.266	0.630	0.284	0.267	0.571	0.133
4	RISK	396.400	0.090	4088.600	0.264	0.263	0.611	0.266	0.290	0.512	0.154
5	OK	426.300	0.090	4321.500	0.263	0.307	0.636	0.297	0.272	0.567	0.148
6	RISK	373.300	0.070	4963.600	0.283	0.254	0.624	0.266	0.281	0.526	0.129
7	RISK	335.400	0.080	5363.500	0.267	0.261	0.606	0.265	0.292	0.561	0.138
8	RISK	343.100	0.080	4612.400	0.253	0.287	0.637	0.307	0.285	0.616	0.144
9	OK	383	0.080	4555.600	0.246	0.275	0.643	0.297	0.301	0.641	0.140
10	OK	375.900	0.080	4203	0.282	0.272	0.614	0.283	0.280	0.563	0.142
11	RISK	372.700	0.070	3471.900	0.286	0.271	0.615	0.296	0.265	0.586	0.130
12	RISK	368.800	0.080	4650.100	0.248	0.314	0.612	0.291	0.300	0.534	0.138
13	OK	368.500	0.070	4843.900	0.243	0.277	0.629	0.278	0.288	0.532	0.130
14	RISK	371.500	0.070	3959.700	0.308	0.297	0.627	0.285	0.276	0.582	0.129
15	OK	376.700	0.090	4201.700	0.253	0.292	0.643	0.318	0.281	0.590	0.145
16	OK	396.800	0.080	5718.500	0.265	0.263	0.629	0.284	0.272	0.580	0.137
17	RISK	388.200	0.080	4609.400	0.253	0.281	0.618	0.330	0.269	0.571	0.140
18	OK	315.200	0.080	3725.600	0.267	0.291	0.639	0.331	0.272	0.610	0.141
19	OK	371.700	0.060	4430.600	0.259	0.294	0.626	0.306	0.284	0.581	0.123
20	RISK	340.300	0.090	4098.400	0.283	0.292	0.649	0.317	0.269	0.597	0.146

Data Preprocessing

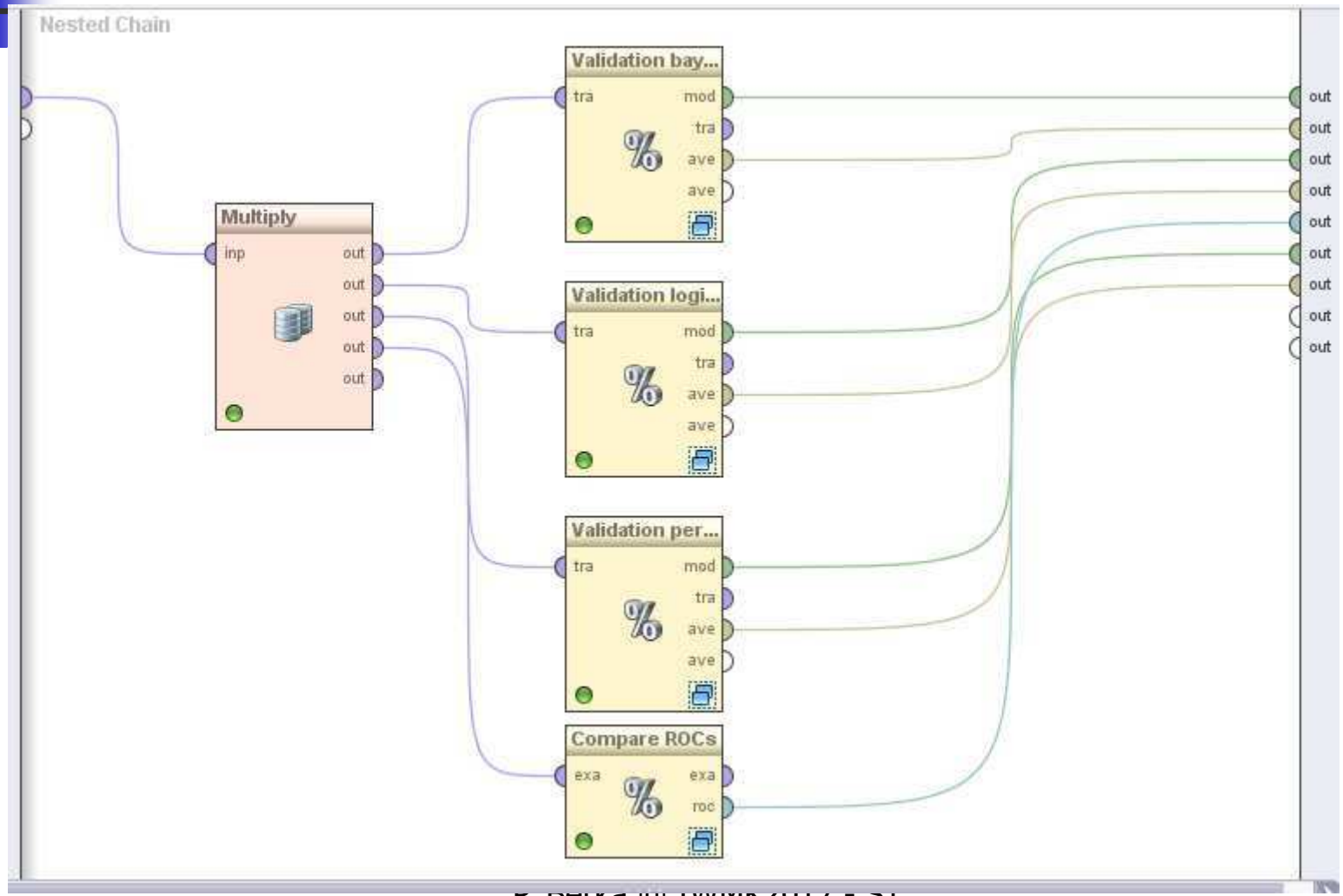


Data used for Training and Testing

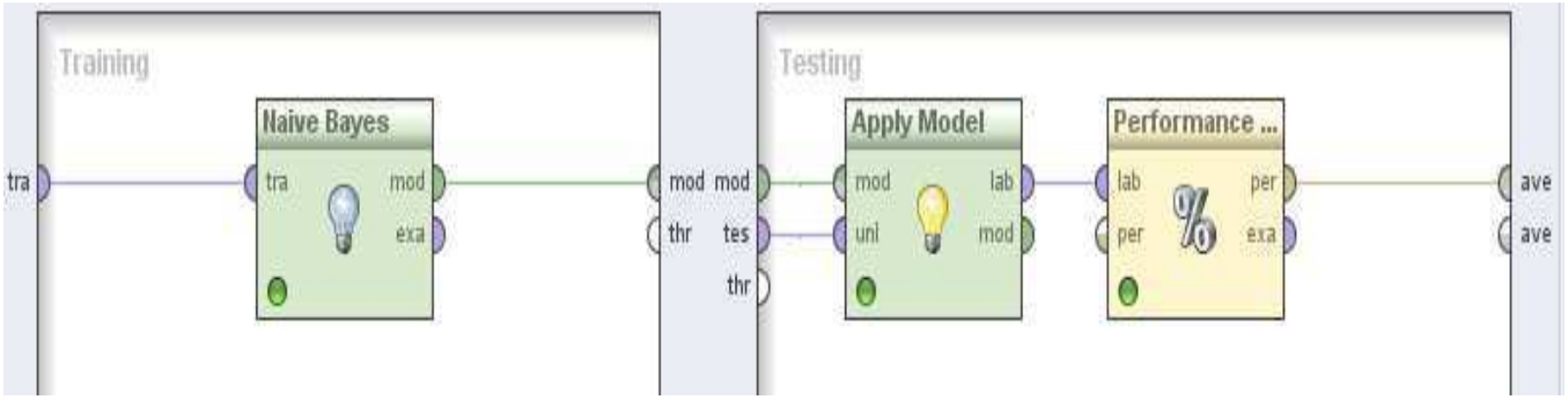
ExampleSet (376 examples, 1 special attribute, 25 regular attributes) View Filter (376 / 376): all

Row No.	Test	Par1	Par7	Par8	Par9	Par10	Par14	Par15	Par16	Par17	Pa
1	OK	437.200	0.308	0.303	0.636	0.139	1.100	1.920	5.410	7.680	12.64
2	OK	351.100	0.275	0.267	0.547	0.135	1.460	2.390	4.120	6.630	11.65
3	OK	382.400	0.284	0.267	0.571	0.133	1.350	2.170	4.150	6.700	10.76
4	RISK	396.400	0.266	0.290	0.512	0.154	1.410	2.320	4.870	6.980	10.97
5	OK	426.300	0.297	0.272	0.567	0.148	1.560	2.450	5.140	5.720	10.98
6	RISK	373.300	0.266	0.281	0.526	0.129	1.100	2.620	5.050	7.030	10.65
7	RISK	335.400	0.265	0.292	0.561	0.138	1.130	2.420	4.620	7.160	10.98
8	RISK	343.100	0.307	0.285	0.616	0.144	1.200	3	4.720	7.480	10.84
9	OK	383	0.297	0.301	0.641	0.140	0.540	2.250	4.310	7.160	10.92
10	OK	375.900	0.283	0.280	0.563	0.142	0.640	3.080	4.310	8.720	10.90
11	RISK	372.700	0.296	0.265	0.586	0.130	1.400	2.360	4.670	8.060	11.49
12	RISK	368.800	0.291	0.300	0.534	0.138	0.920	2.350	4.440	6.650	13.09
13	OK	368.500	0.278	0.288	0.532	0.130	0.830	2.680	4.920	7.690	10.85
14	RISK	371.500	0.285	0.276	0.582	0.129	0.950	2.560	3.840	8.960	10.09
15	OK	376.700	0.318	0.281	0.590	0.145	1.460	2.870	4.380	7.970	12.44
16	OK	396.800	0.284	0.272	0.580	0.137	1.150	2.460	4.930	8.120	12.12
17	RISK	388.200	0.330	0.269	0.571	0.140	0.980	2.460	3.960	6.440	10.85
18	OK	315.200	0.331	0.272	0.610	0.141	0.940	1.940	4.880	5.940	11.45
19	OK	371.700	0.306	0.284	0.581	0.123	1.100	2.540	4.840	6.980	10.40
20	RISK	340.300	0.317	0.269	0.597	0.146	0.960	2.290	4.590	7.740	10.27

Training and Testing



Validation


Training
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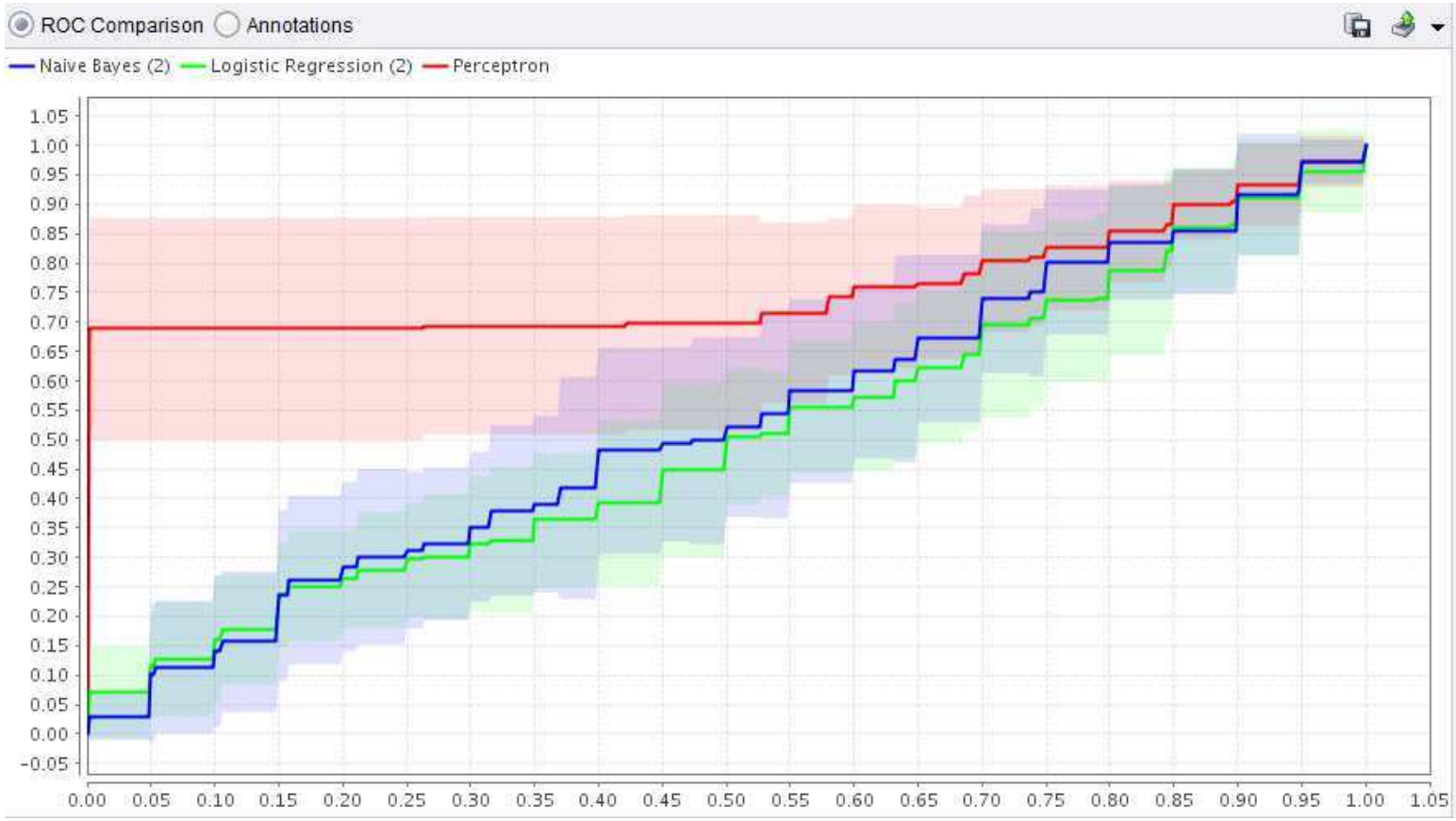
Comparing ROC



Využitie systému WEKA v CAQ

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Seminar on Data mining tools and CAQ (S1)

Vysoká škola manažmentu v Trenčíne

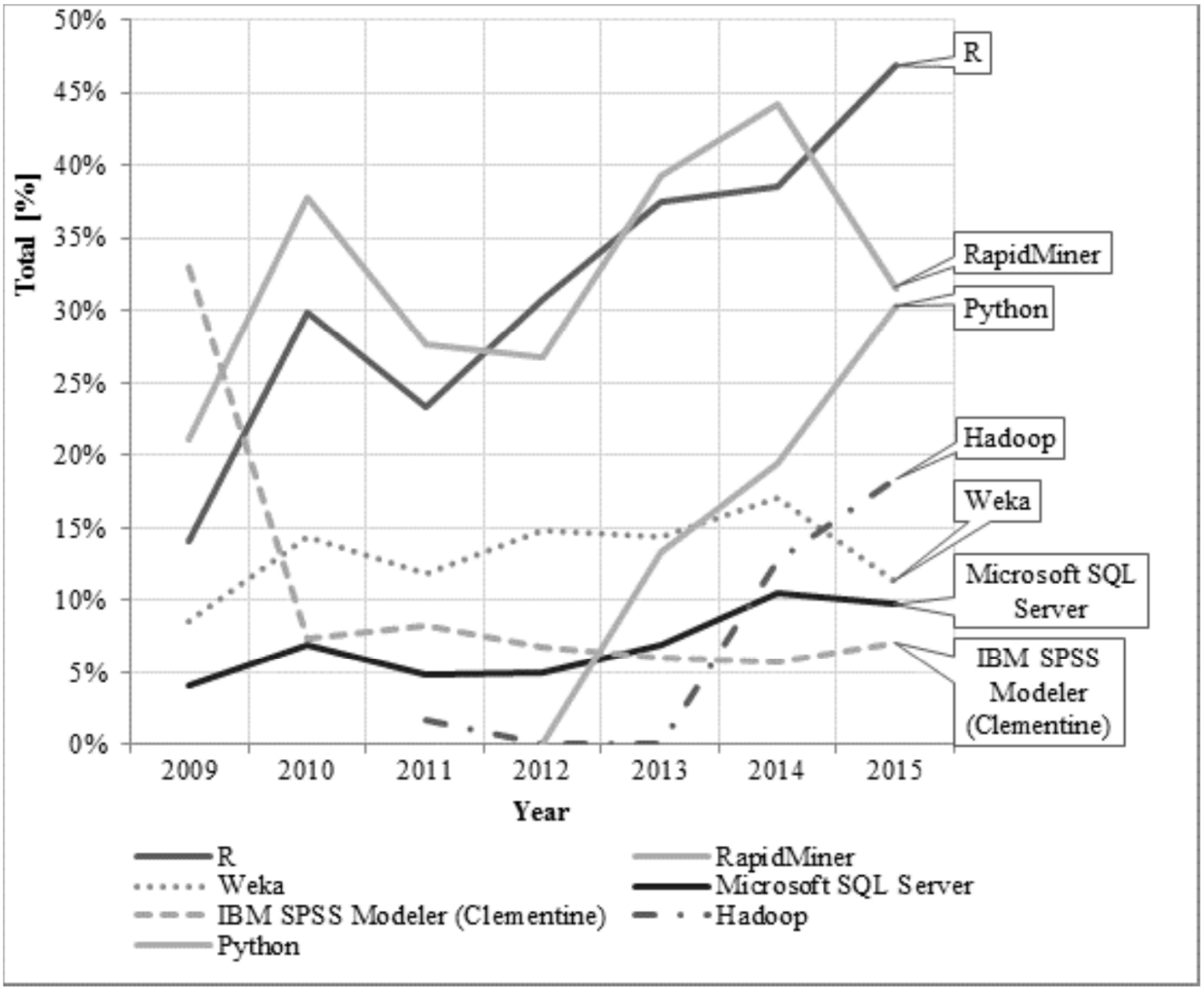
International Workshop on Knowledge Management
IWKM‘2017

Trenčín 12 - 13. 10. 2017

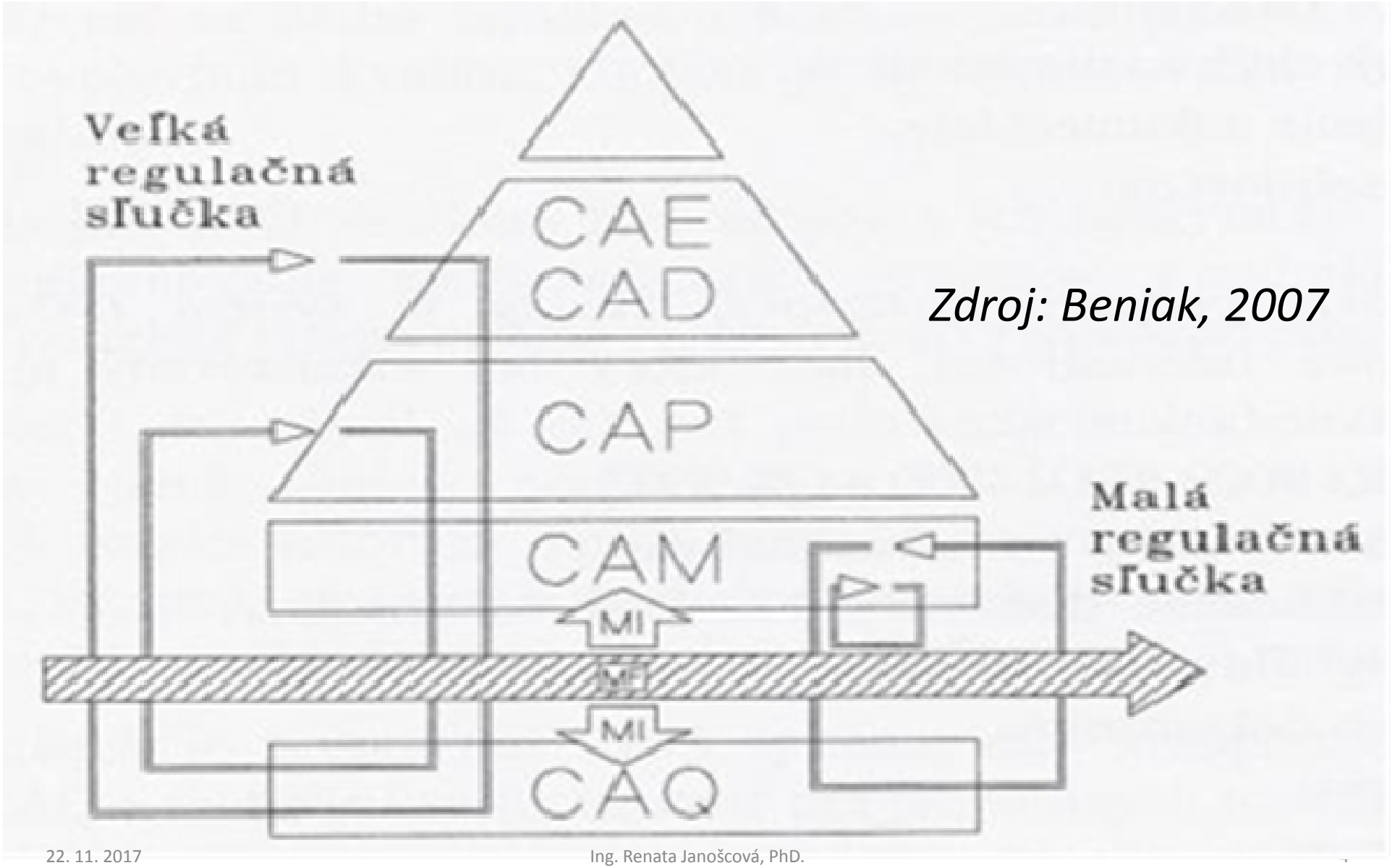
Data mining

- **Stretávame sa s rôznymi výrazmi pre data mining:**
- “dobývání znalostí z databází” (Berka, 2003), “hĺbková analýza údajov” (Terek, 2009), “objavovanie znalostí v databázach” (Paralič, 2003), “získavanie poznatkov z databáz” (Janošcová a Jurišová, 2012), “data mining” (Turčínek et al., 2013)
- Zaujímavou definíciou data miningu, s ktorou sa stotožňuje prof. M. Terek (EU Bratislava) je:
- "Data mining je proces objavovania rôznych modelov, zhrnutie a odvodzovanie hodnôt z danej kolekcie dát" (Kantardzic, 2011)
- **Dnešný trh ponúka mnoho nástrojov (softvérových systémov) pre analytiku, Big data a data mining**

Trendy využívania vybraných softvérových nástrojov pre DM (2009 – 2015)



CAQ ako súčasť CAx systémov



Zdroj: Beniak, 2007

CAQ ako nástroj kvalitného riadenia

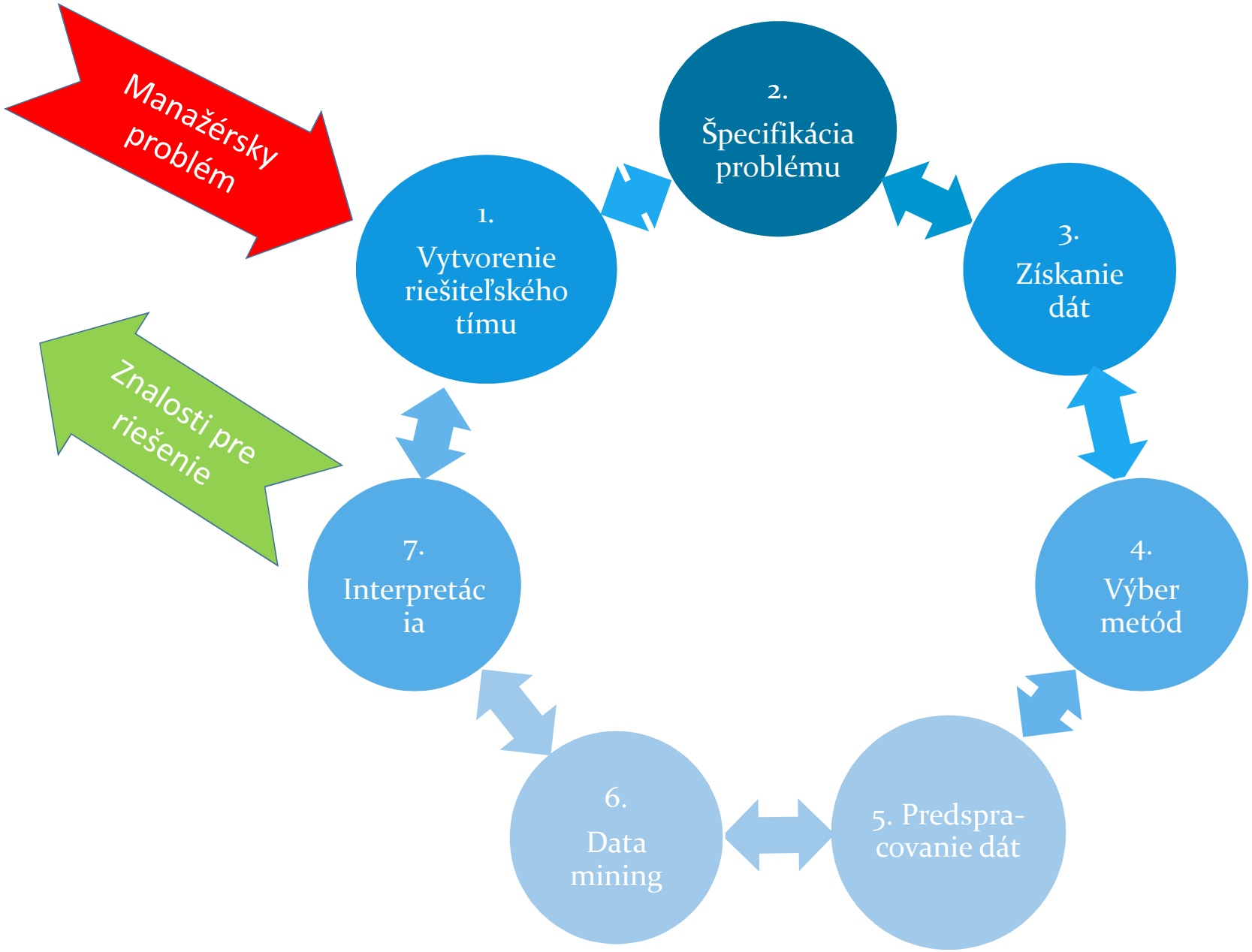
- J. Palán (2003) predpovedal, že „**řízení kvality je vlastně kvalitní řízení...**“
  - Môžeme pritom pozorovať, že CAQ sa tu postupne **mení na kvalitné manažérstvo**, a to s podporou IS/IKT
- **CAQ v širšom ponímaní** chápeme ako **IS pre podporu SMK vo všetkých etapách životného cyklu a hodnotového reťazca produktu**
  - Takto chápaný systém **CAQ prechádza naprieč CIM** ako aj **naprieč integrovanými podnikovými informačnými systémami**
- Takéto systémy CAQ riadia procesy tak, aby sa výskyt nekvalitných produktov minimalizoval - **nereagujú až po vzniku nekvalitnej produkcie, ale jej predchádzajú, a dokonca ju predikujú**
  - (ISO 9000)

Data mining a QM

- Harding, J. A. a kol. (2006, s. 970-976) poukazuje na relevantnosť dolovania z dát **v oblasti výroby a kvality produkcie**:
  - Vo výrobných procesoch, operáciách
  - **Pri detekcii porúch, údržbe**
  - **Pri podpore rozhodovania**
  - **Pri zlepšovaní kvality**
  - Pri riadení vzťahov so zákazníkmi
  - Pri plánovaní budúcej výroby, a tď.

- „**Techniky dolovania z dát majú tendenciu byť oveľa pokročilejšie** než jednoduché **SPC** nástroje“ - uvádza SPC expert (Pyzdek, 2013)
- **KDD – Knowledge Discovery in Databases**

KDD – manažérsky pohľad (Anand a kol., 1996)



Špecifikácia problému

- V procese výroby predmetného výrobku (n*1000 ks/zmenu) **vznikajú rôzne nezhody**, odhalené až na výstupnej 100 % vizuálnej kontrole
- Prebieha testovanie rizikového dielca výrobku (v prístrojovom teste **sa skúma podrobne 13 charakteristík** rizikového dielca , testovanie trvá cca týždeň, testuje sa 1 model za mesiac)
- **V prípade nezhody na testovanom dielci/dielcoch** výrobca pristupuje k **nápravným opatreniam** (100 % kontrola a roztriedenie celej mesačnej produkcie predmetného výrobku)
- V rizikovej dávke býva **30 – 50 % nezhodných kusov** výrobkov

- **Zdroj:** HRICKO, M. Využívanie hĺbkovej analýzy údajov pri zlepšovaní kvality produkcie. Dizertačná práca. EU v Bratislave. FHI. Školiteľ: prof. Ing. Milan Terek, PhD. Bratislava: FHI EU, 2014.

Cieľ - predikovania nekvalitnej výroby

- **Analýza historických dát z reálneho výrobného podniku**, pôsobiaceho v oblasti automobilovej výroby s cieľom predikovať nekvalitnú výrobu

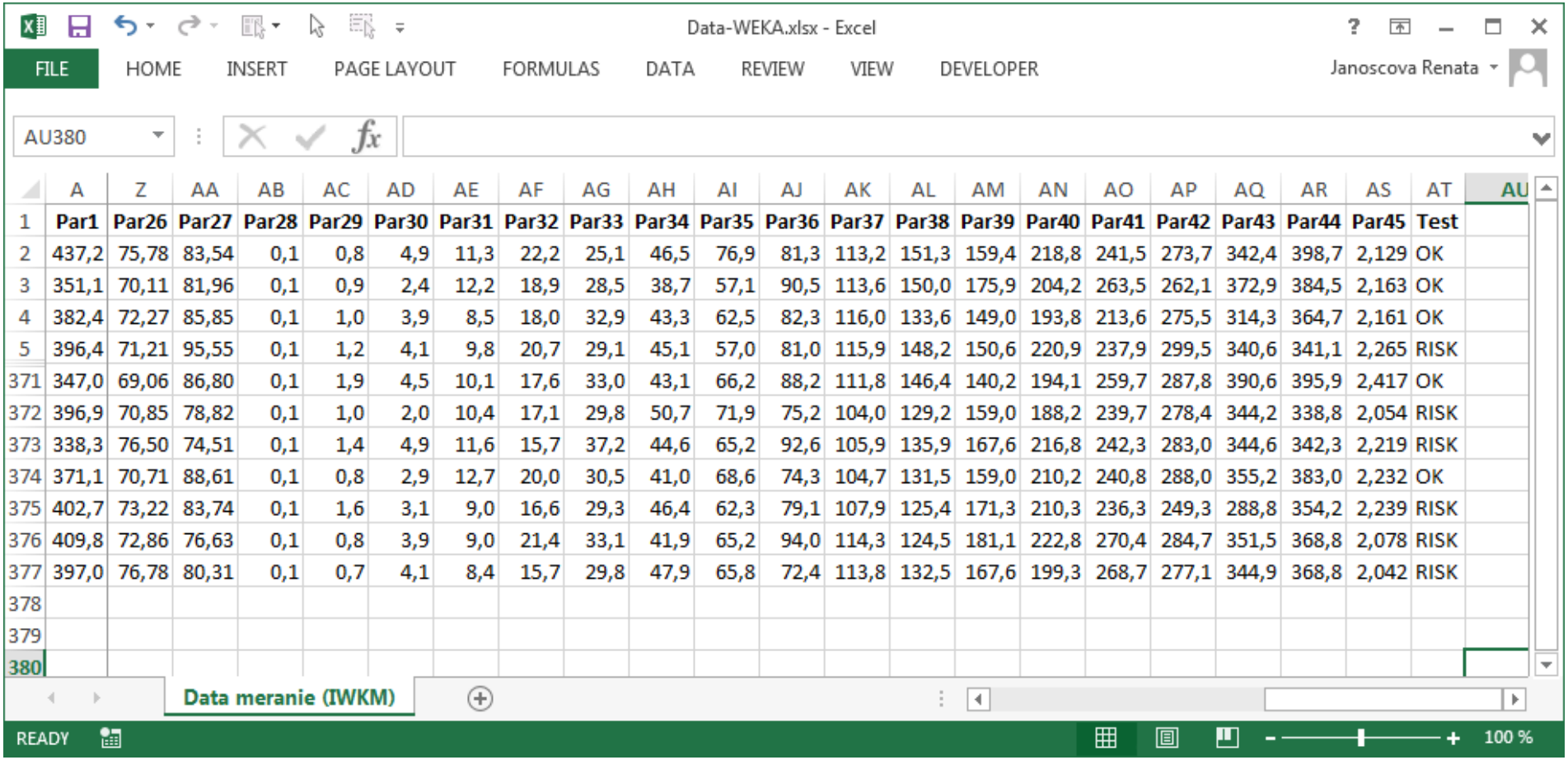
- **Úloha: Pomocou DM v procese KDD zistiť, či výrobca môže na výrobku, označenom ako zhodný, odhaliť použitie rizikovej súčiastky z potencionálne rizikovej dávky**

- **Výstup: Vytvoriť mechanizmus upozornenia**, ktorý by v predstihu informoval o tom, **že riziková súčiastka výrobku môže byť z rizikovej výrobnej dávky** a včasné informovanie materskej firmy o **možnej nezhodnej dávke výrobku**

Získanie dát

- **Bolo potrebné zistiť hraničné hodnoty,** ktoré budú slúžiť na identifikáciu toho, či je **výrobná dávka** použitej rizikovej súčiastky **riziková,** alebo **zhodná**

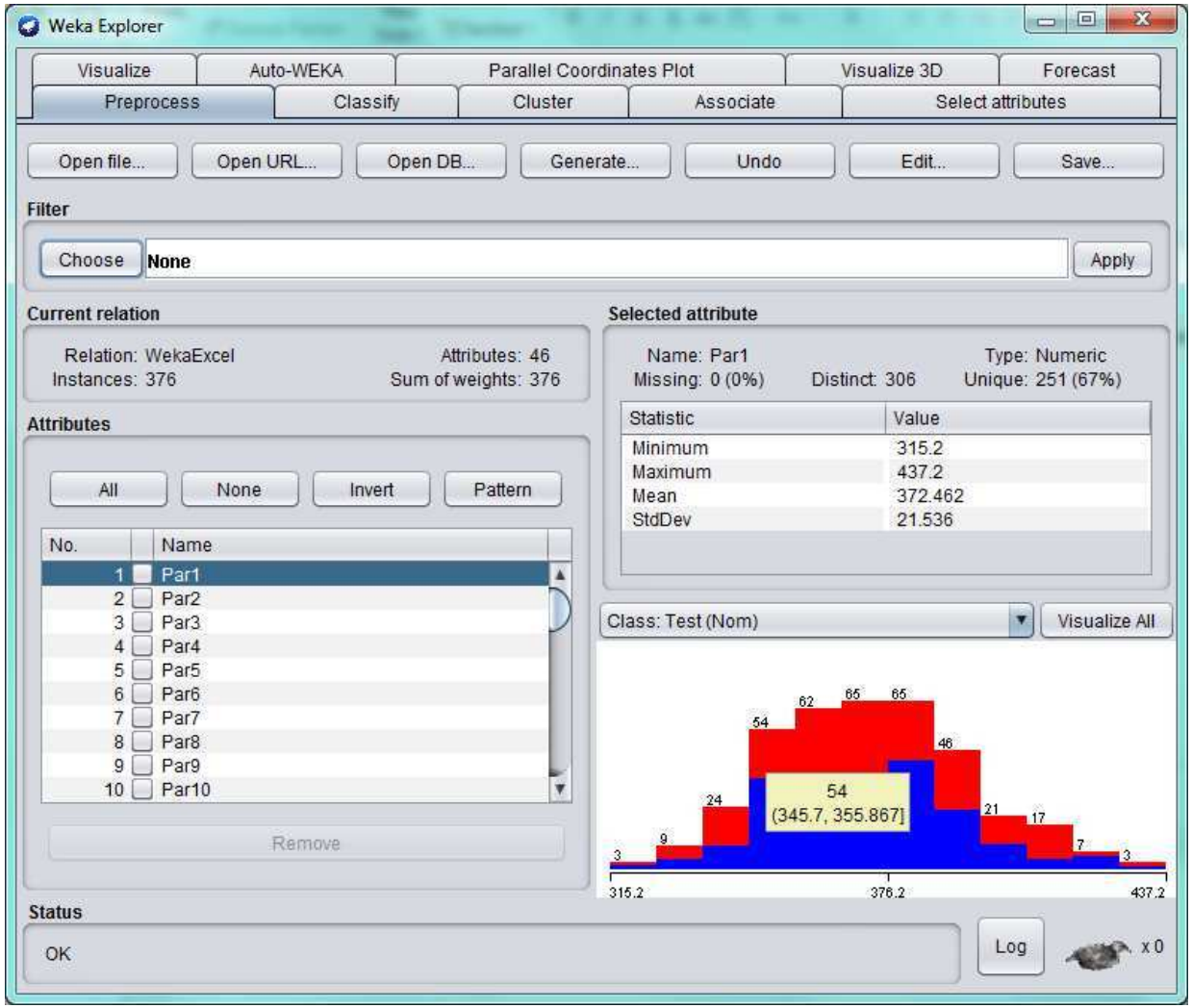
- Každý parameter má **cieľovú hodnotu, MIN a MAX**
- **Výsledok testovania** výrobkov je binárny: **0 (obsahuje zhodnú súčiastku)**, **1 (obsahuje súčiastku z rizikovej dávky)**
- **Historické dáta** – vzorka zložená len zo zhodných produktov
- **Rozdelenie do dvoch množín** (riziková, vyhovujúca)
- Pomer trénovacej a testovacej množiny: **50 % : 50 %**



	A	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
1	**Par1**	**Par26**	**Par27**	**Par28**	**Par29**	**Par30**	**Par31**	**Par32**	**Par33**	**Par34**	**Par35**	**Par36**	**Par37**	**Par38**	**Par39**	**Par40**	**Par41**	**Par42**	**Par43**	**Par44**	**Par45**	**Test**	
2	437,2	75,78	83,54	0,1	0,8	4,9	11,3	22,2	25,1	46,5	76,9	81,3	113,2	151,3	159,4	218,8	241,5	273,7	342,4	398,7	2,129	OK	
3	351,1	70,11	81,96	0,1	0,9	2,4	12,2	18,9	28,5	38,7	57,1	90,5	113,6	150,0	175,9	204,2	263,5	262,1	372,9	384,5	2,163	OK	
4	382,4	72,27	85,85	0,1	1,0	3,9	8,5	18,0	32,9	43,3	62,5	82,3	116,0	133,6	149,0	193,8	213,6	275,5	314,3	364,7	2,161	OK	
5	396,4	71,21	95,55	0,1	1,2	4,1	9,8	20,7	29,1	45,1	57,0	81,0	115,9	148,2	150,6	220,9	237,9	299,5	340,6	341,1	2,265	RISK	
371	347,0	69,06	86,80	0,1	1,9	4,5	10,1	17,6	33,0	43,1	66,2	88,2	111,8	146,4	140,2	194,1	259,7	287,8	390,6	395,9	2,417	OK	
372	396,9	70,85	78,82	0,1	1,0	2,0	10,4	17,1	29,8	50,7	71,9	75,2	104,0	129,2	159,0	188,2	239,7	278,4	344,2	338,8	2,054	RISK	
373	338,3	76,50	74,51	0,1	1,4	4,9	11,6	15,7	37,2	44,6	65,2	92,6	105,9	135,9	167,6	216,8	242,3	283,0	344,6	342,3	2,219	RISK	
374	371,1	70,71	88,61	0,1	0,8	2,9	12,7	20,0	30,5	41,0	68,6	74,3	104,7	131,5	159,0	210,2	240,8	288,0	355,2	383,0	2,232	OK	
375	402,7	73,22	83,74	0,1	1,6	3,1	9,0	16,6	29,3	46,4	62,3	79,1	107,9	125,4	171,3	210,3	236,3	249,3	288,8	354,2	2,239	RISK	
376	409,8	72,86	76,63	0,1	0,8	3,9	9,0	21,4	33,1	41,9	65,2	94,0	114,3	124,5	181,1	222,8	270,4	284,7	351,5	368,8	2,078	RISK	
377	397,0	76,78	80,31	0,1	0,7	4,1	8,4	15,7	29,8	47,9	65,8	72,4	113,8	132,5	167,6	199,3	268,7	277,1	344,9	368,8	2,042	RISK	
378																							
379																							
380																							

- Skúmaná vzorka má **45 atribútov** (parametrov)
- Počet prípadov pre DM – **376**
- Výsledok testovania – v závislom atribúte **Test**

Popisné štatistiky (preskúmanie dát)



- Minimum
- Maximum,
- Priemer,
- Smerodajná odchýlka
- Medián
- Počet
- Počet chýbajúcich hodnôt
- Typ
- Počet unikátnych hodnôt
- ...

Výber metód - WEKA

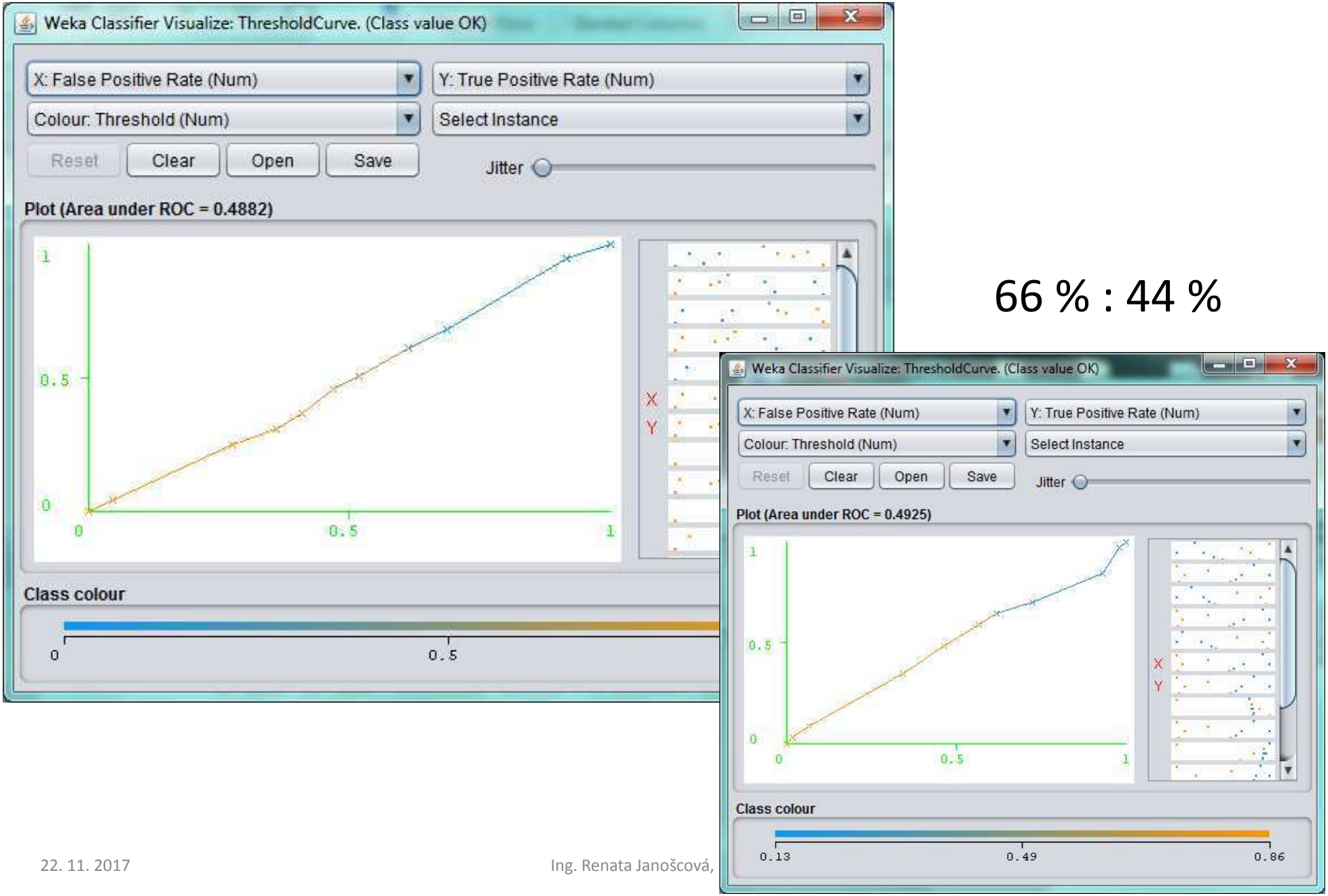
- 1999, New Zealand, „free software“
- Základné funkcionality
  - **Príprava dát** (podpora rôznych formátov, filtre, ...)
  - **Klasifikácia** (rozhodovacie/klasifikačné stromy)
  - **Klastering**
  - **Asociácie**
  - **Výber atribútov**
  - **Vizualizácia dát** (závislosti, NS, BS, 2D, 3D,...)
  - **Forecast**

Data mining

- Vytvoríme 3 modely rozhodovacích stromov (RS):
- **CART** (*classification and regression tree)* – pri výbere atribútu vetvenia RS využíva hodnotu **Gini indexu** (min) (**SimpleCART**)
- **C4.5** – na vetvenie využíva hodnotu **informačného zisku** (*information gain*) – (**J48**)
- **User clasifier**

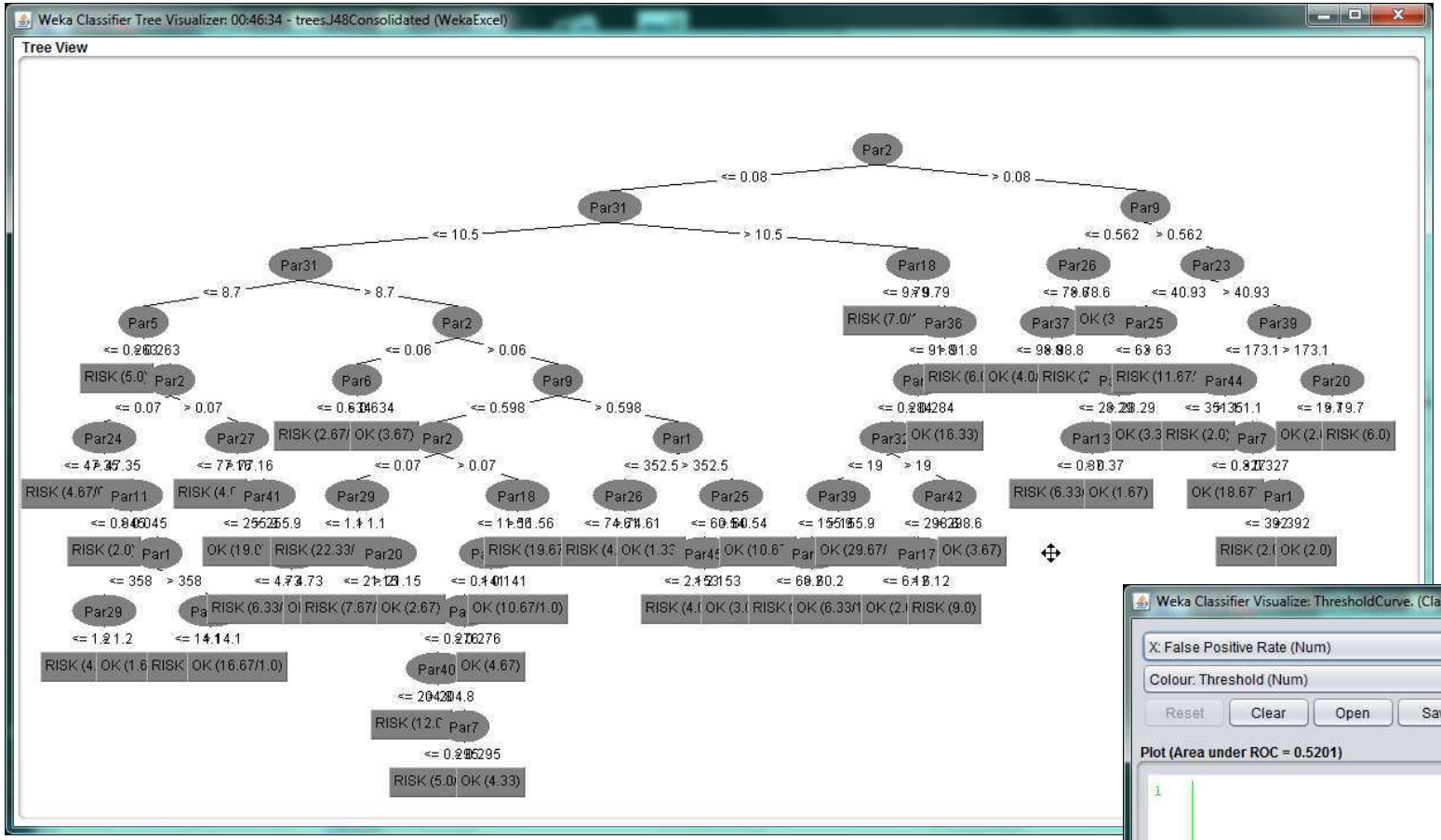
- **Kritériá:**
- premenné pri vetvení nebudú viac krát použité
- maximálny počet vetvení na jednej úrovni - 2
- maximálna hĺbka stromu (teda počet úrovní mimo koreňového uzla - 10
- vytvoriť najmenší rozhodovací strom s najlepším hodnotením

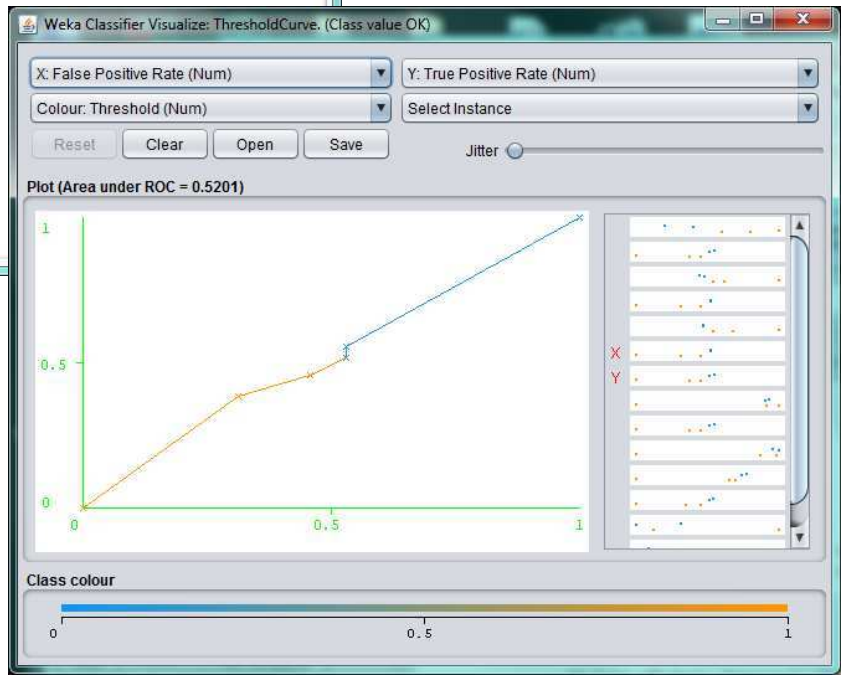
CART Decision Tree



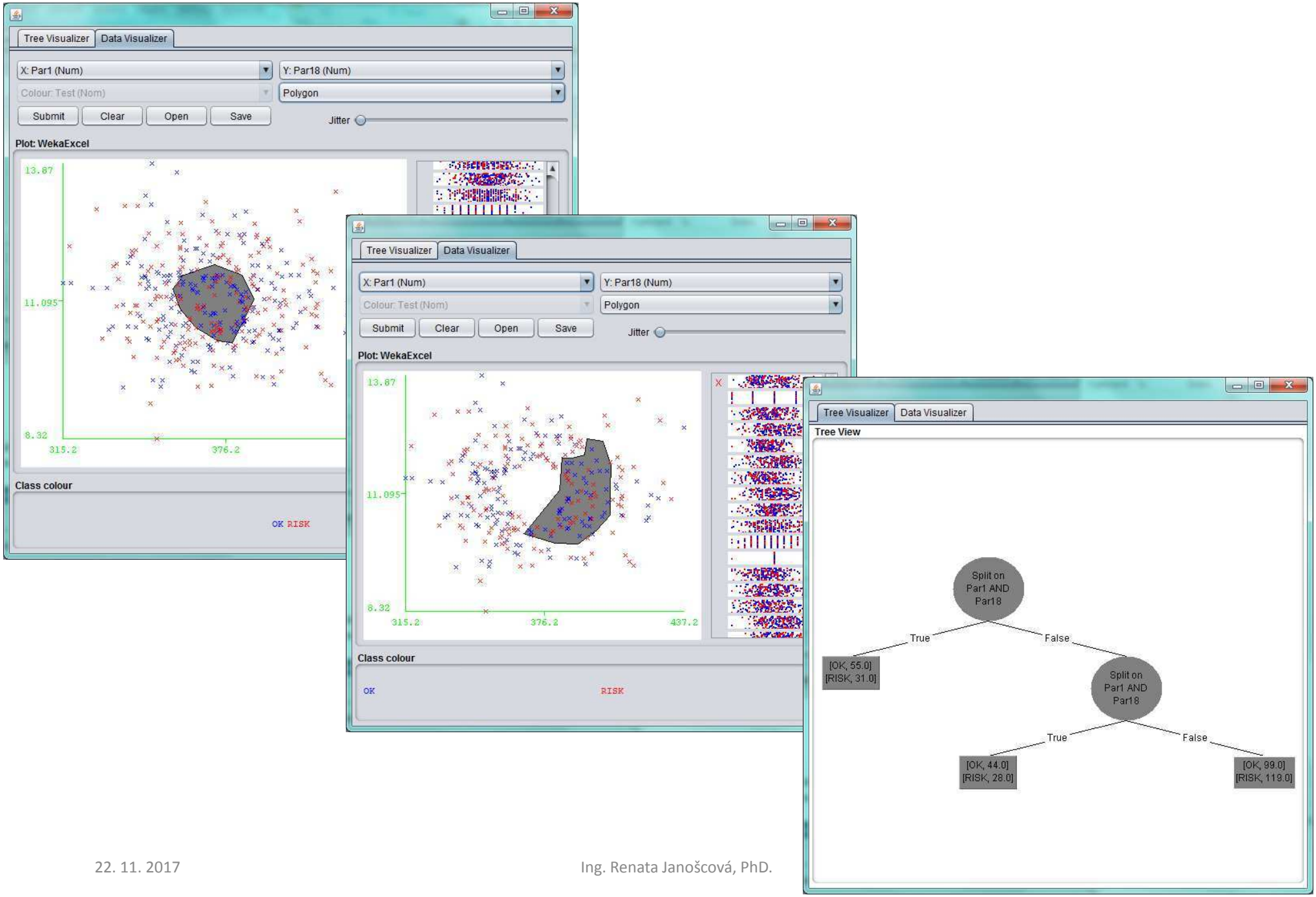
66 % : 44 %

J48 Consolidated pruned tree





User Classifier



Porovnanie modelov

Algoritmus (trénovanie : validácia)	Number of Leaf Nodes:	Size of the Tree:	Correctly Classified Instances	Root mean squared error
CART Decision Tree (50 % : 50 %)	**23**	**45**	**49.4681 %**	**0.6453**
J48 Consolidated pruned tree (50 % : 50 %)	49	97	49.4681 %	0.6949
User Classifier (50 % : 50 %)	2	2	44.1489 %	0.5007
CART Decision Tree (66 % : 34 %)	**23**	**45**	**51.5625 %**	**0.5687**

Interpretácia a implementácia

- Prevod „najlepšieho“ rozhodovacieho stromu na pravidlá

Súbor podmienok č. 1		
Par4	≥	0,265
Par21	<	29,69
Par1	<	398,5
Par10	≥	0,147

Počet súborov podmienok = počtu listových uzlov

- Model bol následne zapracovaný do šablóny meracieho protokolu pomocou logických funkcií (**IF - THEN**)

Zdroje

- BERKA, P. 2003. *Dobývání znalostí z databází*. Praha : Academia
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- TURČÍNEK, P., MOTYČKA, A. & KOSOVÁ, A. 2013. *Economic Data Classification by Means of Machine Learning Methods*. Paris, Recent Advances in Information Science, Proceedings of the 4th European Conference of Computer Scienc, pp. 1-6.

Ďakujem za pozornosť

Process Mining

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Seminar on Data mining tools and CAQ (S1)

Vysoká škola manažmentu v Trenčíne

International Workshop on Knowledge Management
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Trenčín 12 - 13. 10. 2017


BIG
DATA
PROCESS REVOLUTION STARTS
IN BIG DATA UNDERGROUND


BIG DATA
BIG DATA

Eventlog


BIZZ
DISCO CLUB
& ami
monarquia-club.com
Warm up by
SABADO
OUTUBRO
EDDIE
FERREIROS

Data entries

(enterprise database data in cloud or on premises)

System logs

(in form of documents, click streams, XML data)


Check order numbers
Compare of sums
Get lowest approval level
Approving on specific level
Shift to higher level
Status change to Accounted

Check order numbers

Compare of sums

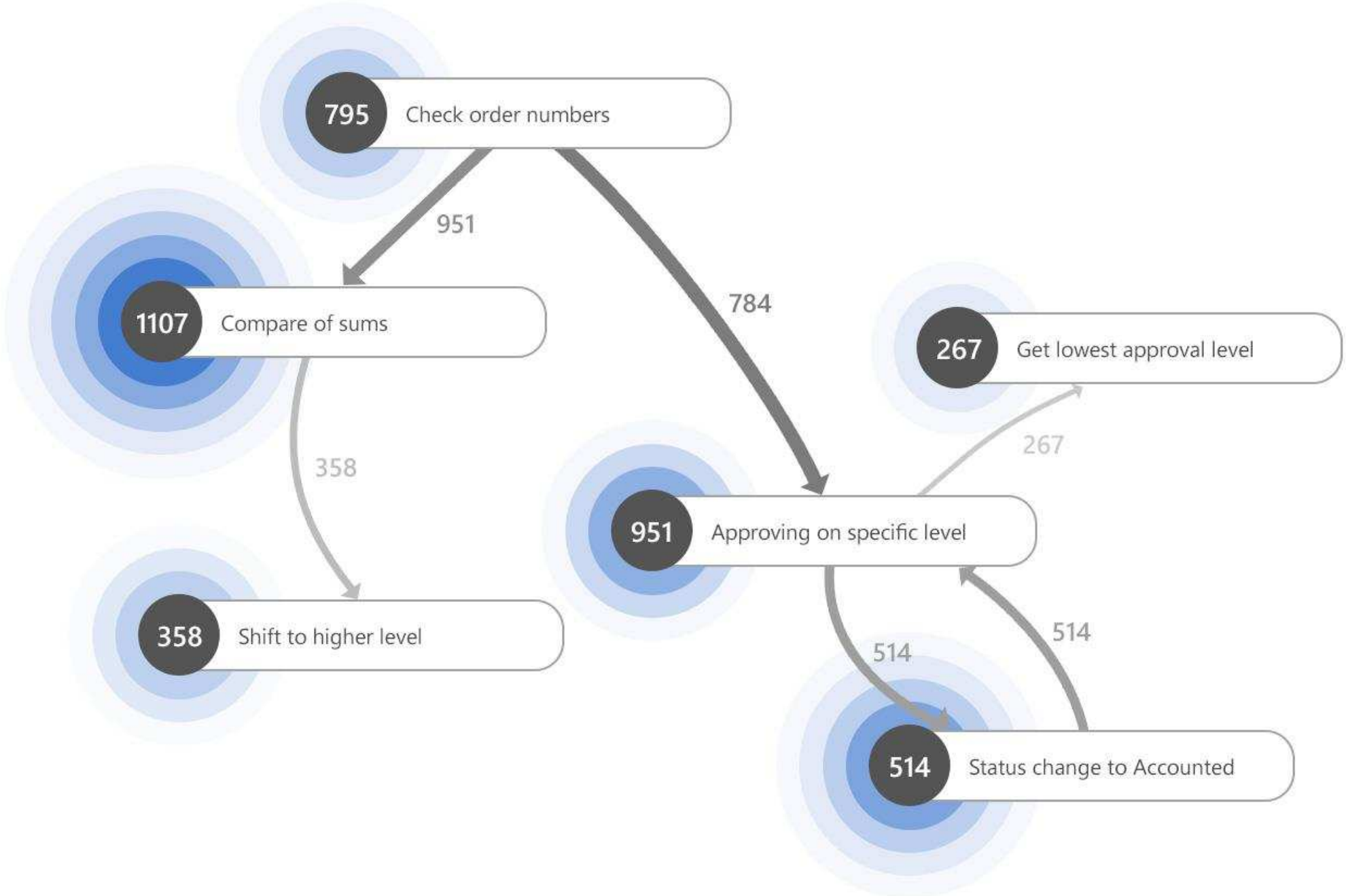
Get lowest approval level

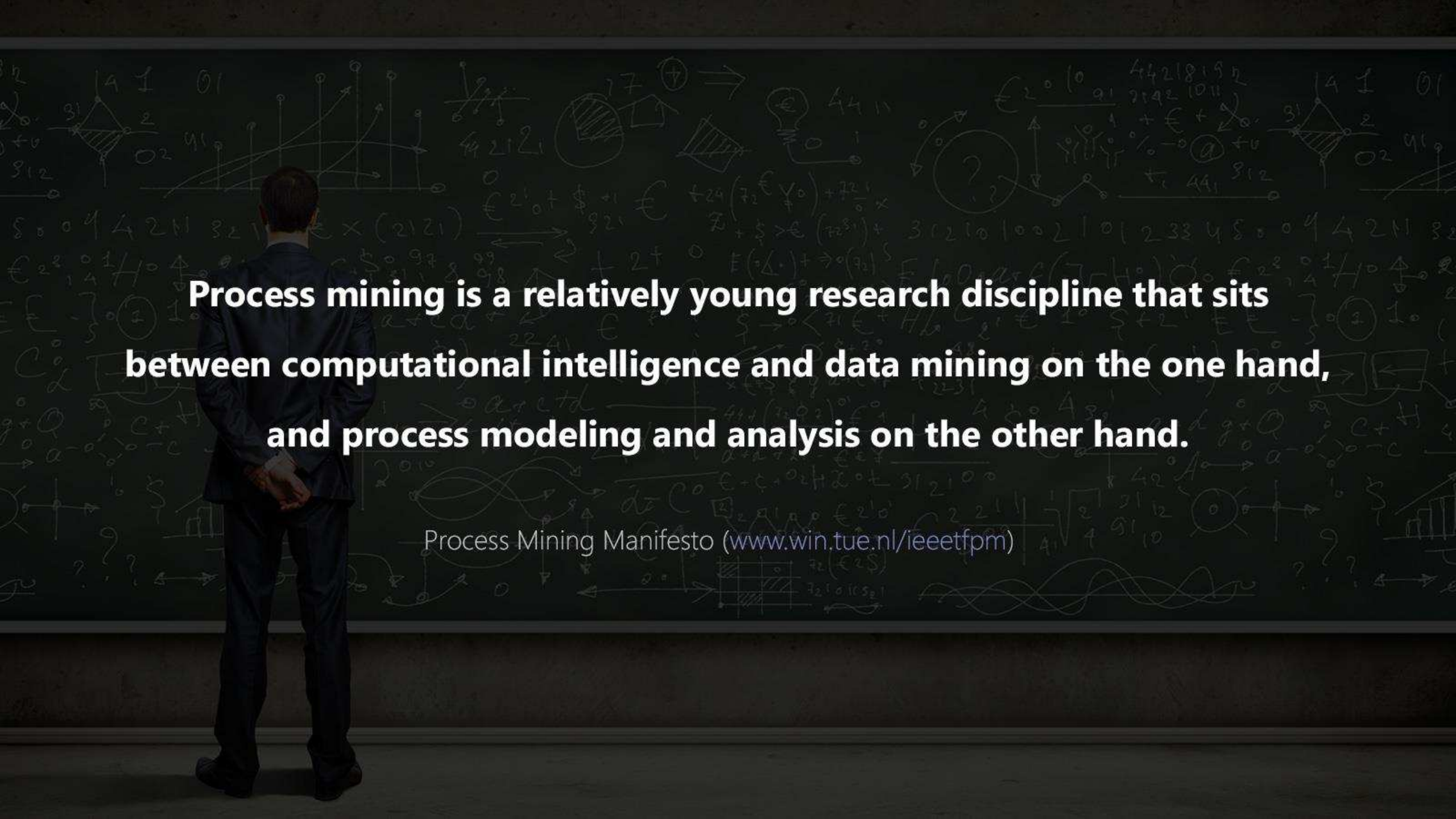
Approving on specific level

Shift to higher level

Status change to Accounted


795
Check order numbers
1107
Compare of sums
267
Get lowest approval level
951
Approving on specific level
358
Shift to higher level
514
Status change to Accounted


795
Check order numbers
951
784
1107
Compare of sums
267
Get lowest approval level
267
358
951
Approving on specific level
514
514
358
Shift to higher level
514
Status change to Accounted


Process mining is a relatively young research discipline that sits between computational intelligence and data mining on the one hand, and process modeling and analysis on the other hand.
Process Mining Manifesto (www.win.tue.nl/ieeetfpm)

PROCESS REVOLUTION

subjective

adjective | sub·jec·tive | \(ˌ)səb-ˈjek-tiv\

relating to the way a person experiences things in his or her own mind

limited

adjective | lim·it·ed | \ˈli-mə-təd\

confined within limits : restricted <limited success>

exception

noun | ex·cep·tion | \ik-ˈsep-shən\

a case where a rule does not apply

visibility

noun | vis·i·bil·i·ty | \ˌvi-zə-ˈbi-lə-tē\

capability of being readily noticed


minit

VSM (City University)

Personalized University

Analytical Results

- Comparing A & B grade students to E graders
- 7 activities revealed in their flow
- Rising activity by 50% and redistributing in time

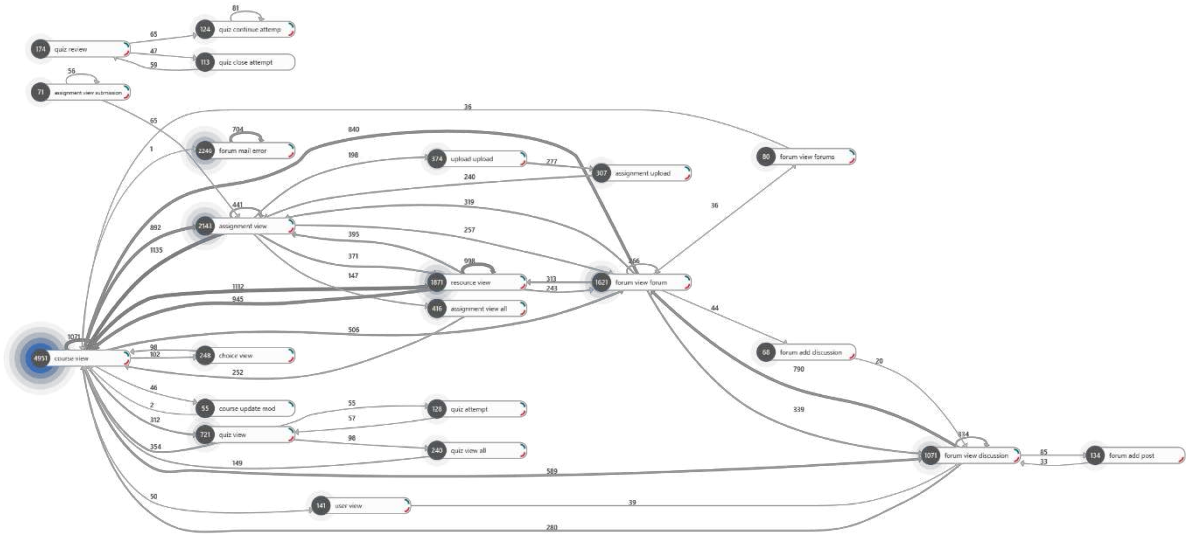
Outcome

- Easier student onboarding
- Best practice guide

Phase 1 – Overview

Low height flight over moodle data

Results

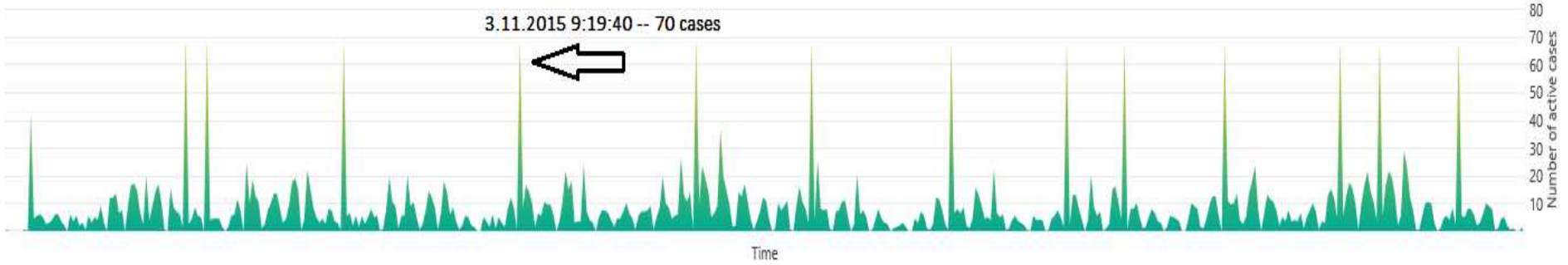


Info

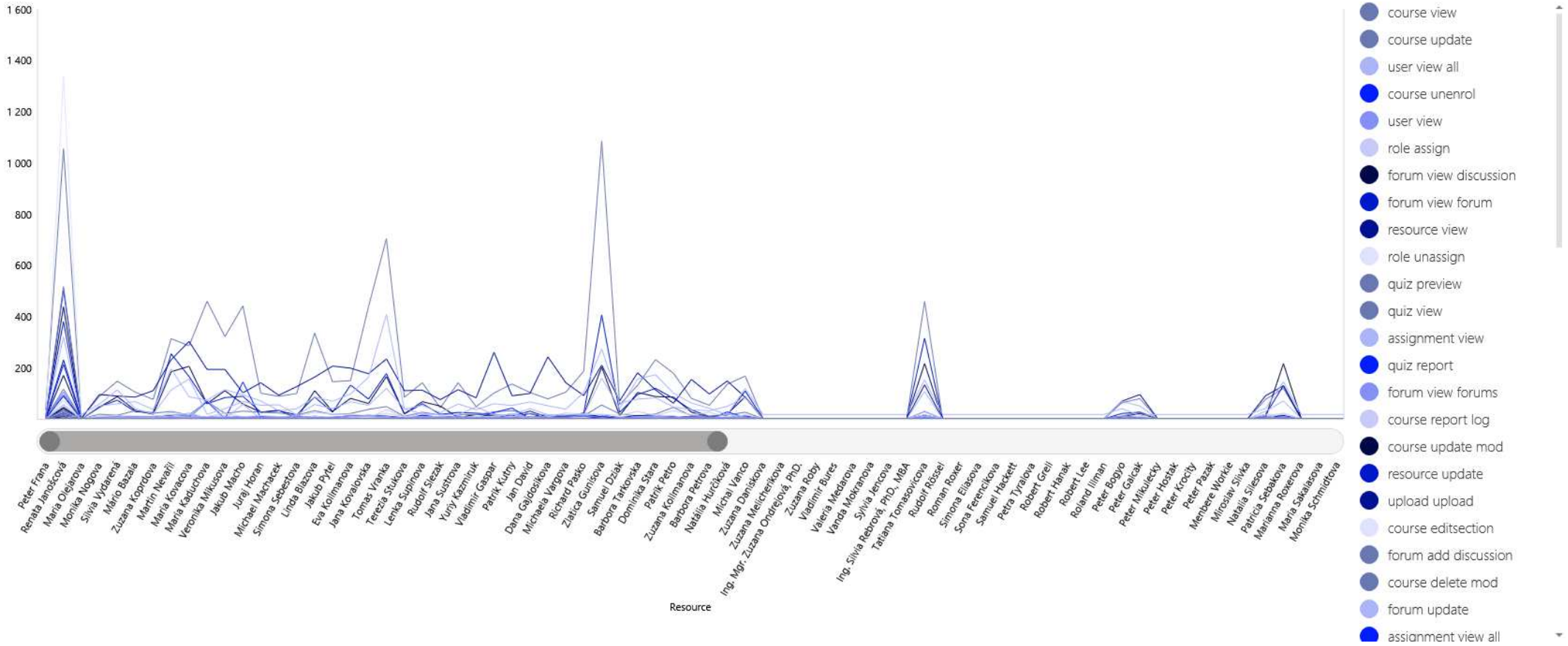
2. ZADANIE	175	70%
AKTIVITA 2 (denní študenti)	48	19%
1. ZADANIE	24	10%
AKTIVITA 1 (denní študenti)	4	2%

Info

PRÍKLAD č.1	34	17%
PRÍKLAD č.2	30	15%
V 4. týždni NEZABUDNITE! - v utorok - uče	23	11%
Príklad 2	20	10%
Príkald 1	18	9%
PRÍKLAD č.3	11	5%



Results


1 600
1 400
1 200
1 000
800
600
400
200
Peter Frana
Renata Janošcová
Maria Olejárova
Monika Nogova
Silvia Vydarená
Mário Bazala
Zuzana Koprdova
Martin Nevařil
Maria Kovacova
Maria Kaduchova
Veronika Mikusova
Jakub Macho
Juraj Horan
Michael Marhacek
Simona Sebestova
Linda Blazova
Jakub Pytel
Eva Kolmanova
Jana Kovalovska
Tomas Vranka
Terezia Stukova
Lenka Supinova
Rudolf Slezak
Jana Sustrova
Yuriy Kazmiruk
Vladimir Gaspar
Patrik Kutny
Jan David
Dana Gajdosikova
Michaela Vargova
Richard Pasko
Zlatica Gunisova
Samuel Dziak
Barbora Tarkovska
Dominika Stara
Patrik Petro
Zuzana Kolmanova
Barbora Petrova
Natália Hurčíková
Michal Vanco
Zuzana Daniskova
Zuzana Melicherikova
Ing. Mgr. Zuzana Ondrejová, PhD.
Zuzana Roby
Vladimir Bures
Valeria Medarova
Vanda Mokranova
Sylvia Jencova
Ing. Silvia Rebrová PhD., MBA
Tatiana Tomasovicova
Rudolf Rössel
Roman Roxer
Simona Eliazova
Sona Ferencikova
Samuel Hackett
Petra Tyralova
Robert Greil
Robert Hanak
Robert Lee
Roland Iliman
Peter Bogyo
Peter Gaicak
Peter Mikulecky
Peter Hostak
Peter Krocity
Peter Pazak
Menbere Workie
Miroslav Slivka
Natália Sliesova
Patrícia Sebaková
Marianna Roxerova
Maria Sakalasova
Monika Schmidtova
Resource
course view
course update
user view all
course unenrol
user view
role assign
forum view discussion
forum view forum
resource view
role unassign
quiz preview
quiz view
assignment view
quiz report
forum view forums
course report log
course update mod
resource update
upload upload
course editsection
forum add discussion
course delete mod
forum update
assignment view all

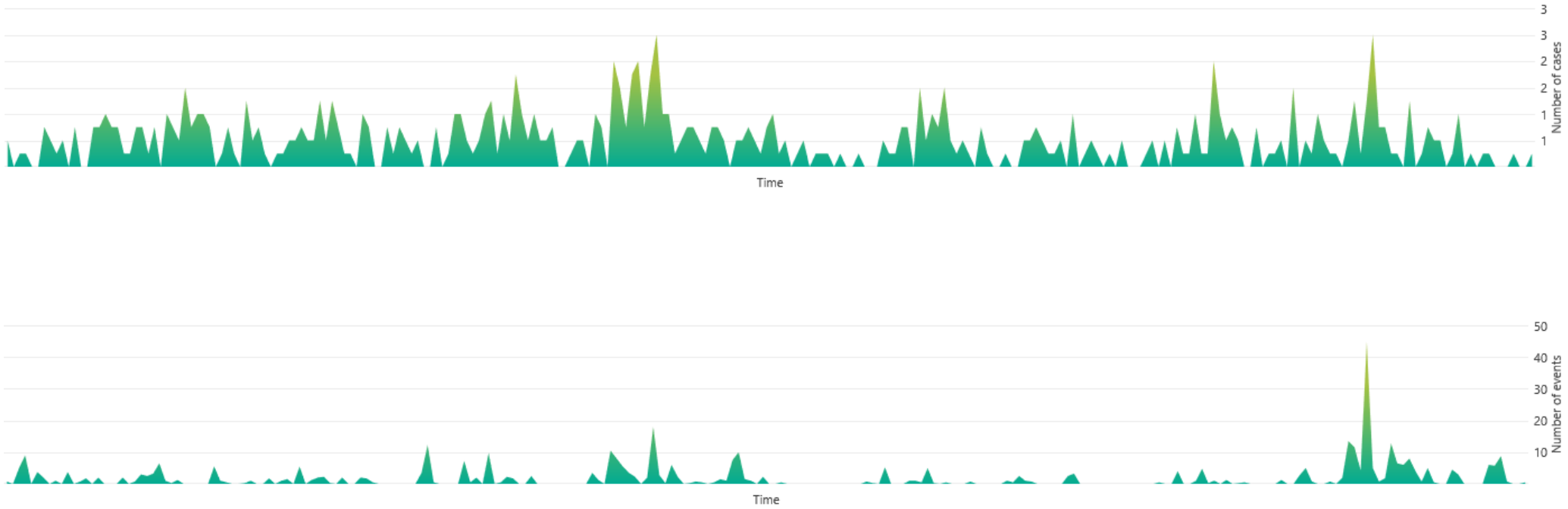
Questions

- Can we focus on a specific study field?
- Are we able to enrich the data with final grades and thus distinguish students?
- Are we able to distinguish the process variants and habits of best performers?
- And what about comparisons to low performers?
- Would it be possible to learn from the best and guide newcomers to achieve better final grades?

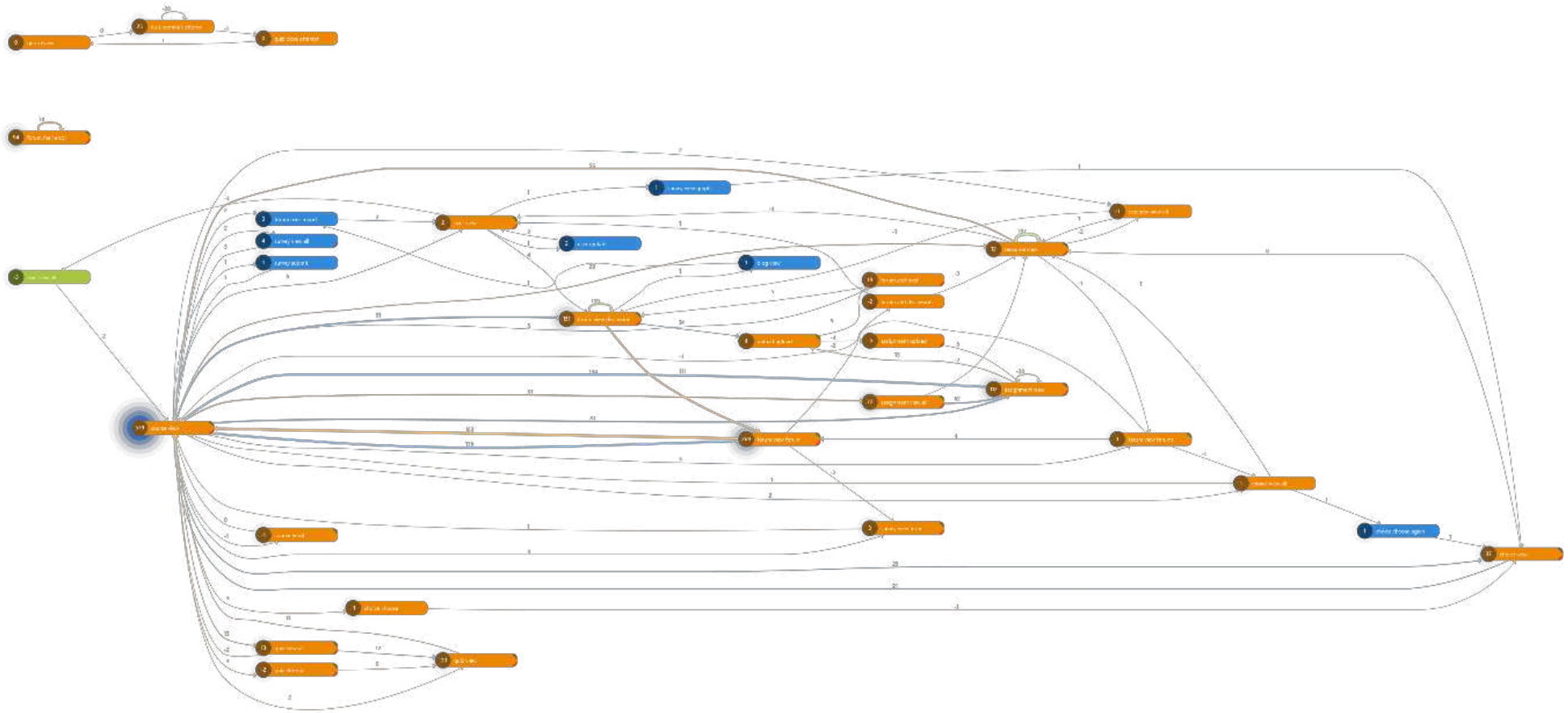
Phase 2 – Deep Insight

Drill-down into online study field based on focused questions

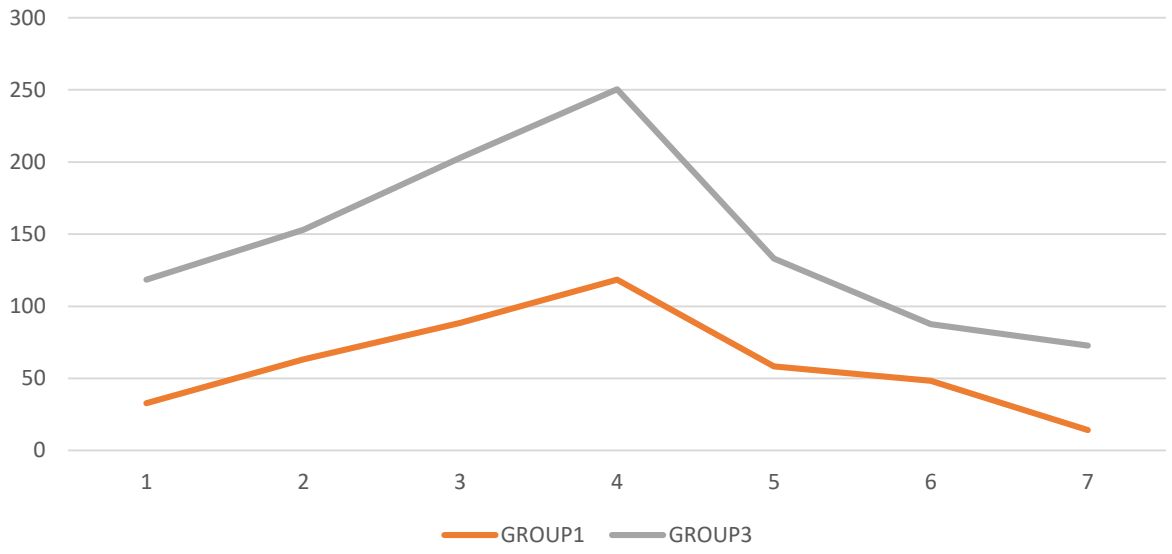
Activity comparison

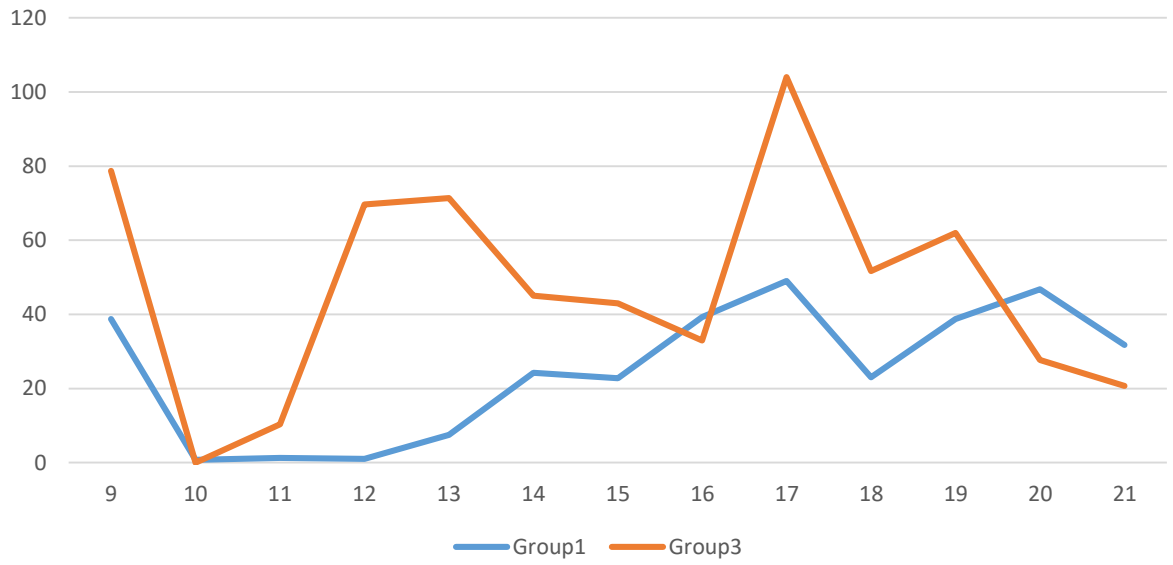


Process comparison



Activity distribution comparison





THANK YOU

Michal Rosik

PRODUCT VISIONARY

As Product Visionary for minit, Michal defines the Research & Development direction for this process mining solution, develops close ties to the academic community in this area and evangelises process mining benefits to enterprises worldwide. Michal previously lead Microsoft Consulting department in Siemens and was involved in several large enterprise projects as a consultant and project manager. In his free time, he is a passionate trail runner.

@michalrosik @minitlabs michal.rosik@minit.io

Run of the panel discussion

Universities, SME's and Knowledge Management (S2)

SOŇA FERENČÍKOVÁ
moderator

ARTHUR RUBENS, LENKA ŠABLATÚROVÁ, FRIDRICH RÁCZ, MICHAL ROSÍK, JOZEF HVORECKÝ
Panelists

Abstract: In order to introduce the key topic of the workshop – the collaboration between business and academia, Seminar 2 was organized in a panel discussion format. Three representatives of business and two university professors. Below we introduce the key elements of their introductory speeches and outline their discussion with audience.

Keywords: University mission, Collaborative learning, Causal loops, Optimal learning strategy, Business-university partnership

Structure of the panel discussion and its main topics

During the first 35minutes every panelist briefly introduced his point of view of the relationship between universities, small and medium enterprises and Knowledge Management. They were asked to prepare short PowerPoint presentations on their recent research in the given area. There were no specific instructions about their talk's particulars. The result was a very interesting mixture that demonstrated the variety of opinions and concepts.

Prof. **Arthur Rubens** introduced the concept of **Entrepreneurial University**. The concept represents the enrichment of two traditional university roles: education and research. The university is here understood as an entrepreneur selling its knowledge. In can be done by the expansion of its historical role – it can prepare specific courses and programs tailored to the business needs and/or accomplish research according to business' specification. These activities bring various benefits to the universities from a financial profit to the reflection of these needs in their study programs.

Dr. **Lenka Šablatúrová** spoke about her experience with such business-tailored courses. She stressed the importance of **Collaborative Learning**. Its key is mutual understanding of needs of both instructors and students. She presented a model of building it. The collaboration must from the very first contact. The students become coauthors of the course content and collaborate on its teaching and learning methodology. Their education is flexible and highly interactive. The goal of teaching is the full comprehension of the learned material rather than its amount.

Dr. **Fridrich Rácz** presented **Causal Loop Diagrams as a tool of Organizational Learning**. He showed that theoretical concepts can be successfully exploited for improving organizational culture. Using Causal Loops, the company's activity and relationships are

mapped. The map can then be used for the indentification by sources of drawbacks – and exploited for their diminishing.

Michal Rosík showed a partially opposite example. Using big data processing of the virtual classroom students', he identified their behavioral patterns during their online education. Some of them result in the successful course completion, others do not. By **Education 4.0** he denoted the application of the findings that might serve as a set of recommendations to the university students. Their application could reduce the number of students' individual failures and, consequently, the university dropout rate.

Finally, Prof. **Jozef Hvorecký** analyzed the mechanisms **Organizing the collaboration between universities and SME's**. He stressed three aspects: Connecting relevant individuals, building working conditions for them and appreciating their efforts. He pointed to the fact that Prof. Rubens' idea of entrepreneurial university faces many challenges in Slovakia due to its conservative atmosphere and low appreciation of changes.

After these speeches, the panelists reacted to their partners' contributions. Each reaction was limited to five minutes and helped to eliminate minor differences in their opinions. In principle, all of them supported the idea of entrepreneurial university as a progressive university model.

Then, the audience was invited to participate in discussion. The participants pointed to the importance of a business-university partnership. Many of them expressed their disappointment about the negative attitude of the Slovak Accreditation Commission which do not value such partnership in its university evaluations. They also appreciated the format of panel and expressed their desire to organize similar panel discussion at other scientific events organized by Vysoká škola manažmentu.

Jozef Hvorecký

Co-chair

Funkcia MES systémov z pohľadu Industry 4.0

Ing. Vladimír Šurka
Tempest a.s.
vladimir_surka@tempest.sk

Seminar on Data mining tools and CAQ (S1)

Vysoká škola manažmentu v Trenčíne

International Workshop on Knowledge Management
IWKM‘2017

Trenčín 12 - 13. 10. 2017

Koncept Industry 4.0

1. •CPS – KYBERNETICKO FYZIKÁLNE SYSTÉMY
2. •INTERNET OF THINGS
3. •INTERNET OF SERVICES
4. •BIG DATA
5. •CLOUD COMPUTING
6. •PRODUCT LIFECYCLE MANAGEMENT SYSTEMS
7. •DIGITAL MANUFACTURING
8. •DIGITAL TWIN

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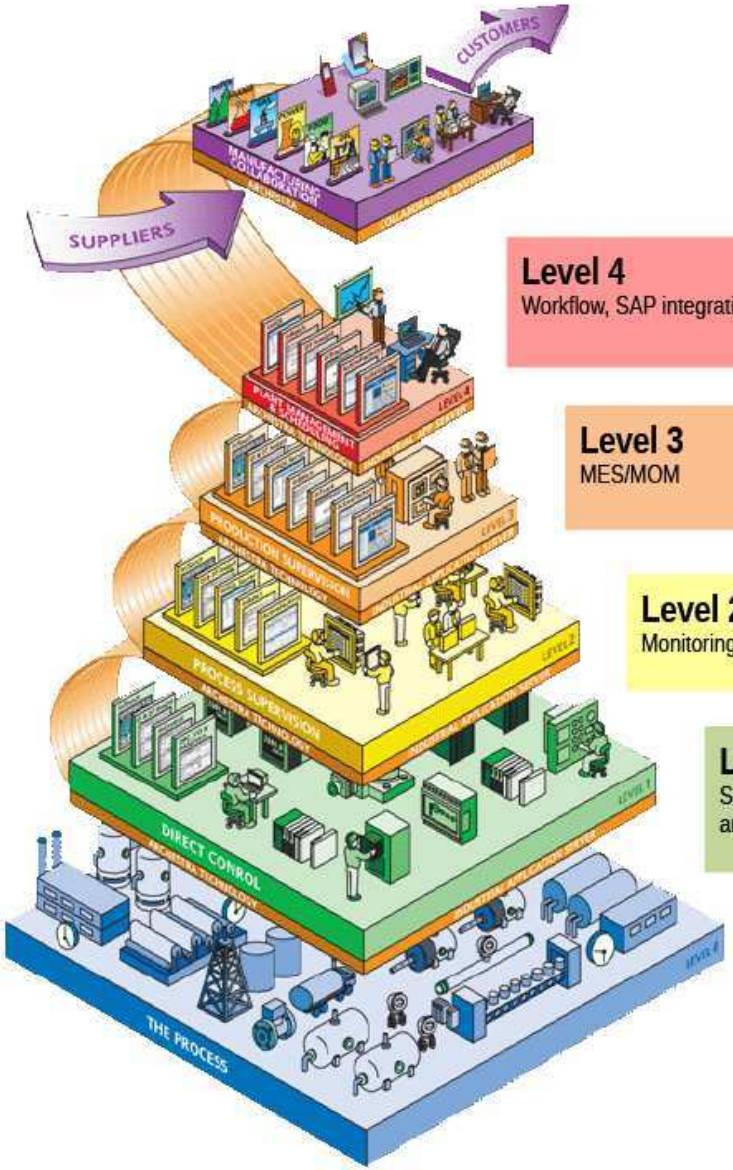


Level 4
Workflow, SAP integration

Level 3
MES/MOM

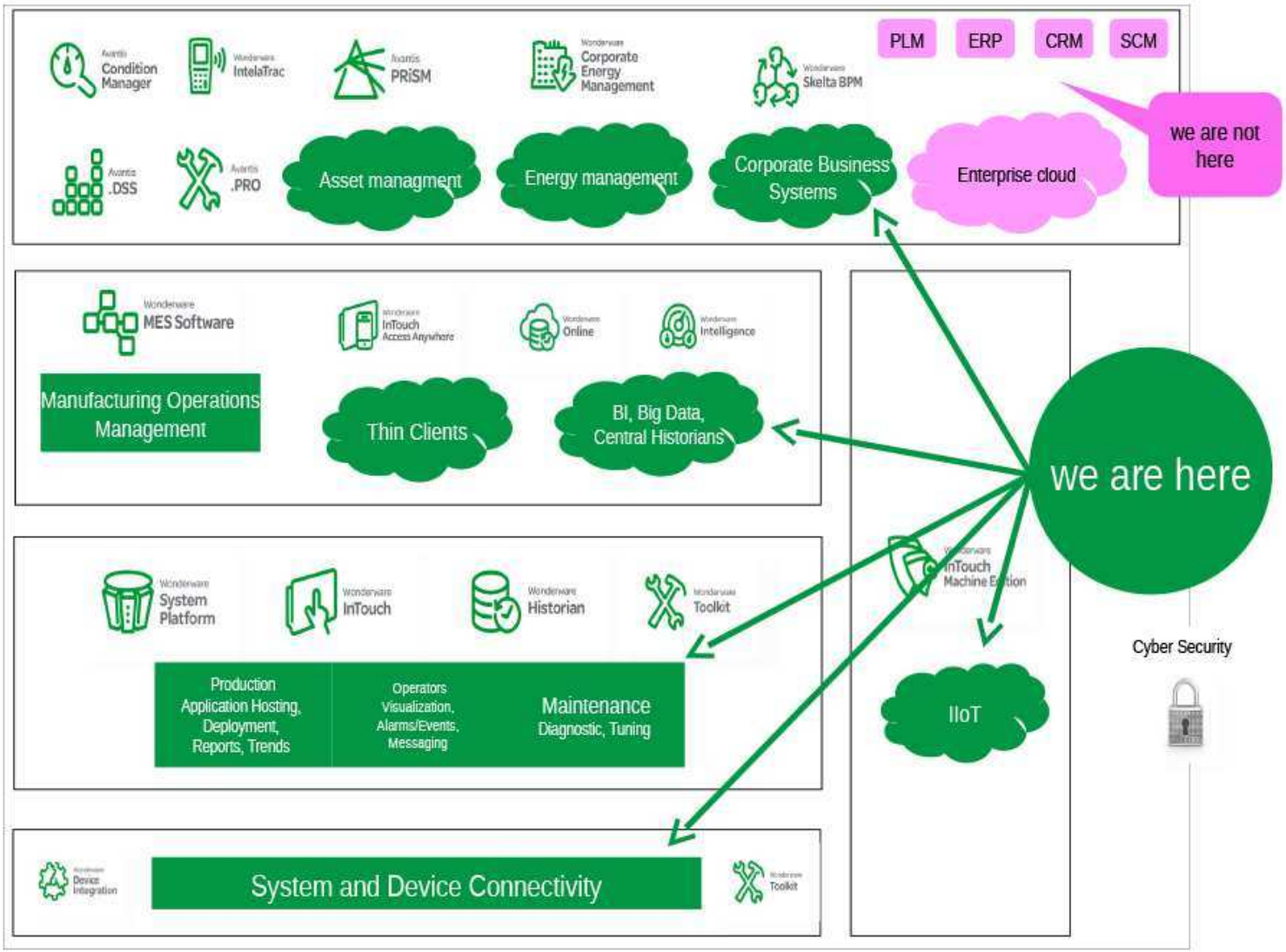
Level 2
Monitoring, supervisory control

Level 1
Sensing the production process and manipulating

Level 0
Actual Production process

we are here levels 1-4

Wonderware - MES



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Wonderware – popis komponentov

Hlavný výpočtový výkon
Virtuálny model technológie

Komunikačné servre
(bývalé DAS)

Historizačný server

Analytický a reportný
real-time web portál

Grafické rozhranie

Analytické a reportné
aplikácie nad
Historian Serverom

Prístup k InTouch
aplikácii cez web

Grafické rozhranie
pre použitie
v rámci IIoT

Výrobný
informačný systém
kategórie MES

Prepojenie MES s
ERP systémami

Drag-and-drop
tvorba reportov

Web portál pre
pokročilú analýzu
alarmov

Mobilné riešenie pre
prístup k techno-
logickým dátam

Štatistické riadenie
výroby (SPC)

Dávkové riadenie
výroby, menežment
receptov

Rýchly prístup k
dátam z Historian
Servera cez web

Riadenie ľudských
procesov vo
výrobných podnikoch

Mobilné riešenie pre
riadenie údržbárs
kych procesov

Verzionovací a
zálohovací nástroj

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Wonderware – rozširujúce komponenty

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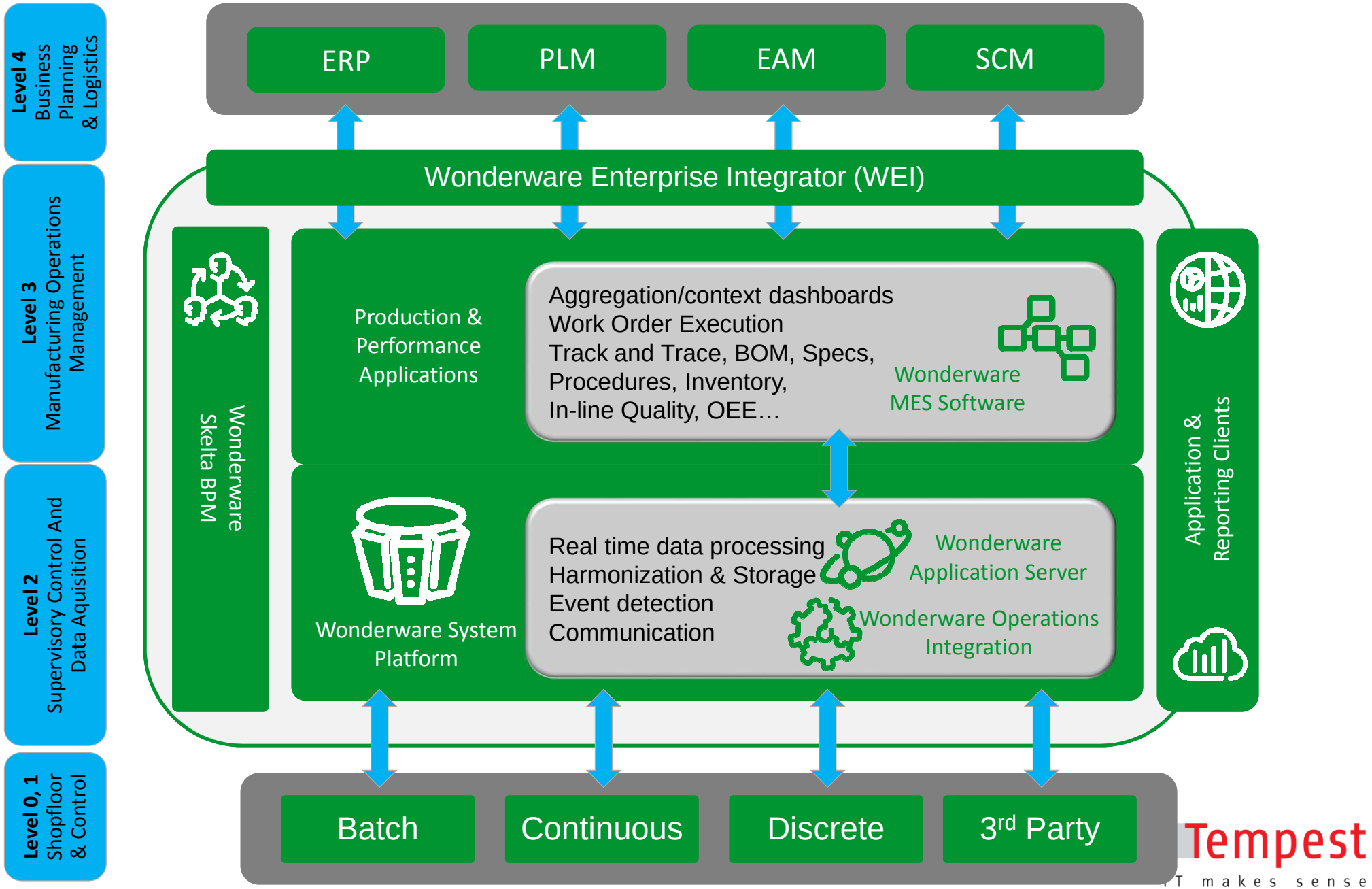
Wonderware – z pohľadu Ind4.0



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Wonderware – MES moduly

Wonderware MES Software

Wonderware MES sa skladá z troch modulov:

MES/Operations

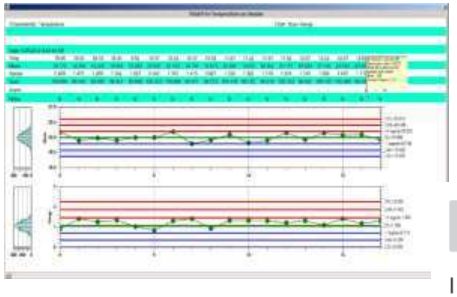
> Riadenie výroby podľa zákaziek z ERP
> Geneaológia výrobkov
> Skladové hospodárstvo
> Riadenie postupov operátorov

MES/Performance

> OEE kalkulácie
> Podpora zvýšenia kapacít jestvujúcich zariadení

MES/Quality

> Identifikácia devicácií kvality v real-time čase
> Kontrola zhody kvality s predpismy
> Automatické ukladanie vzoriek



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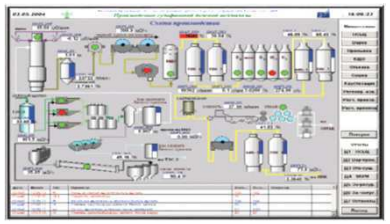
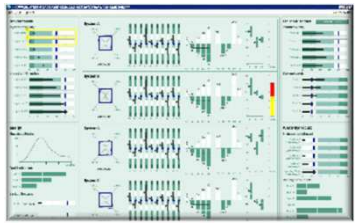
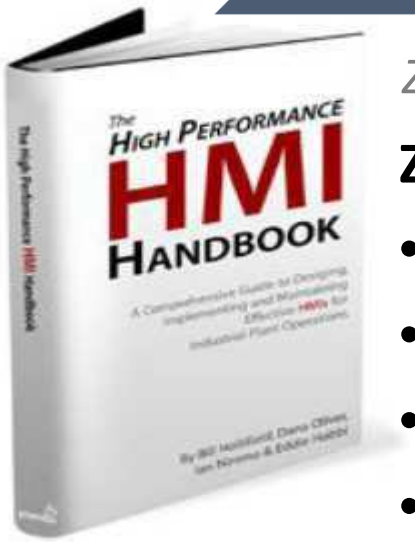
Wonderware – Situational Awareness

HMI zamerané na proces, dáta v kontexte a upriamenie pozornosti operátora



1970's → 1980's → 2000's → Súčasnosť Budúcnosť

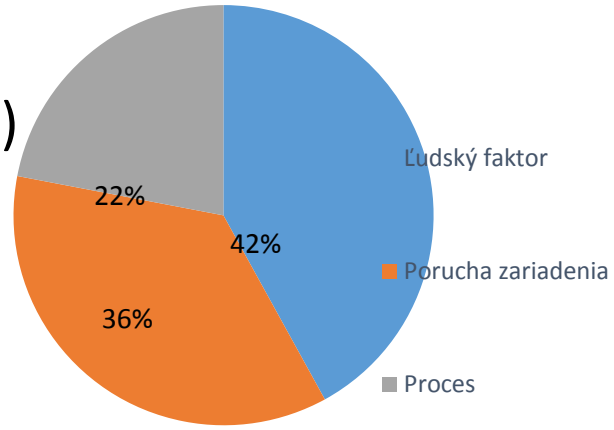


Základom je kniha „High performance HMI" založená na štandarde ISA-101

Zaužívané synonymá:

- High Performance HMI
- Abnormal Situation Management (ASM)
- Operator/User Centered Design
- Situation(al) Awareness
- Advanced Process Graphics
- Human Factors Design

Príčiny havarijných situácií



Zdroj: ASM Consortium

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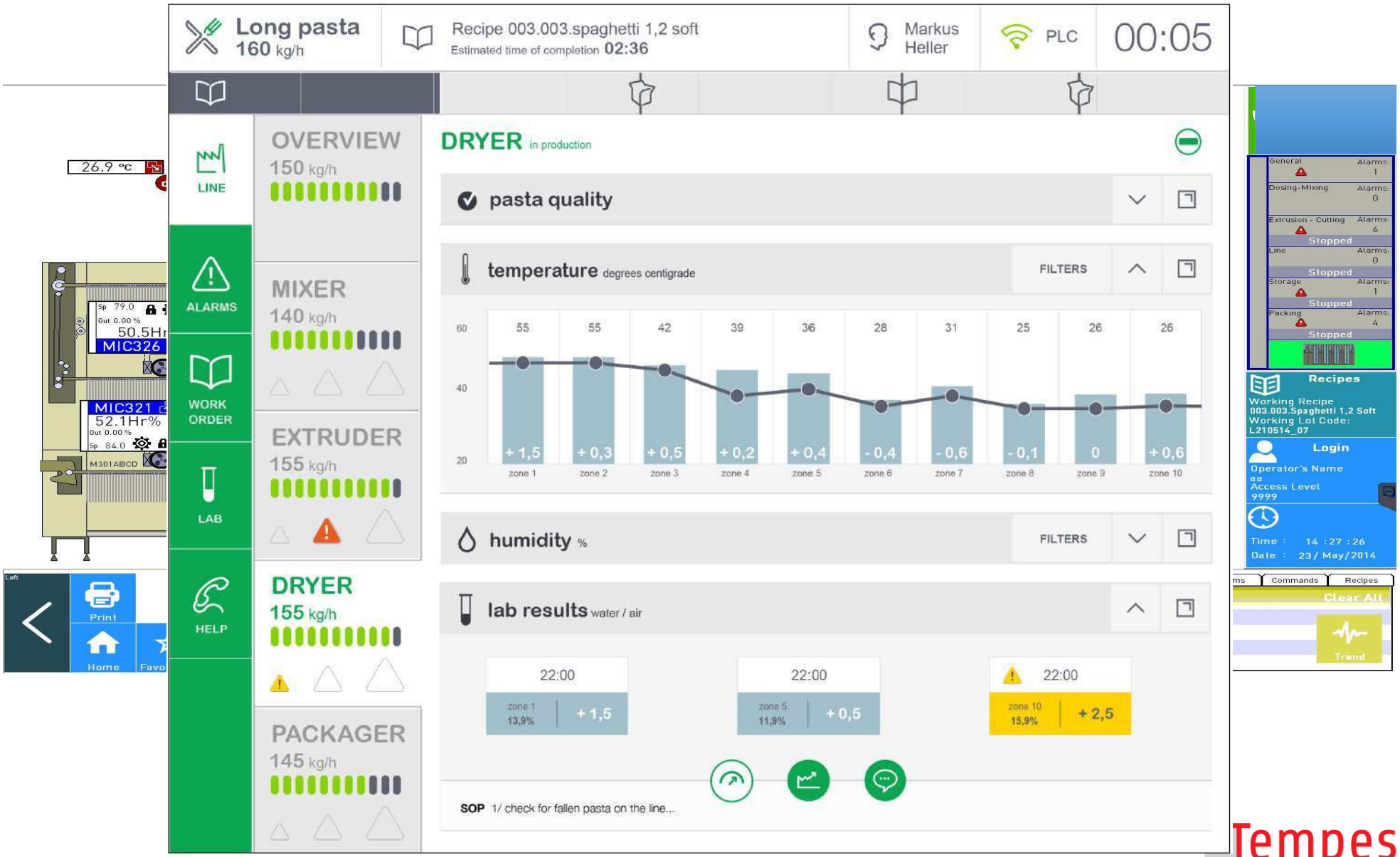
IT makes sense

Wonderware – Situational Awareness

Ukážka obrazovky s princípom Situational Awareness



Tempest
IT makes sense

Wonderware – Situational Awareness

*Kľúčové princípy – **odstránenie nepodstatných informácií***

- Vyzerá t
  väčšina
  na tejto
  irelevan
  riadenia
- Iba tieto
  poskytu
  skutočn

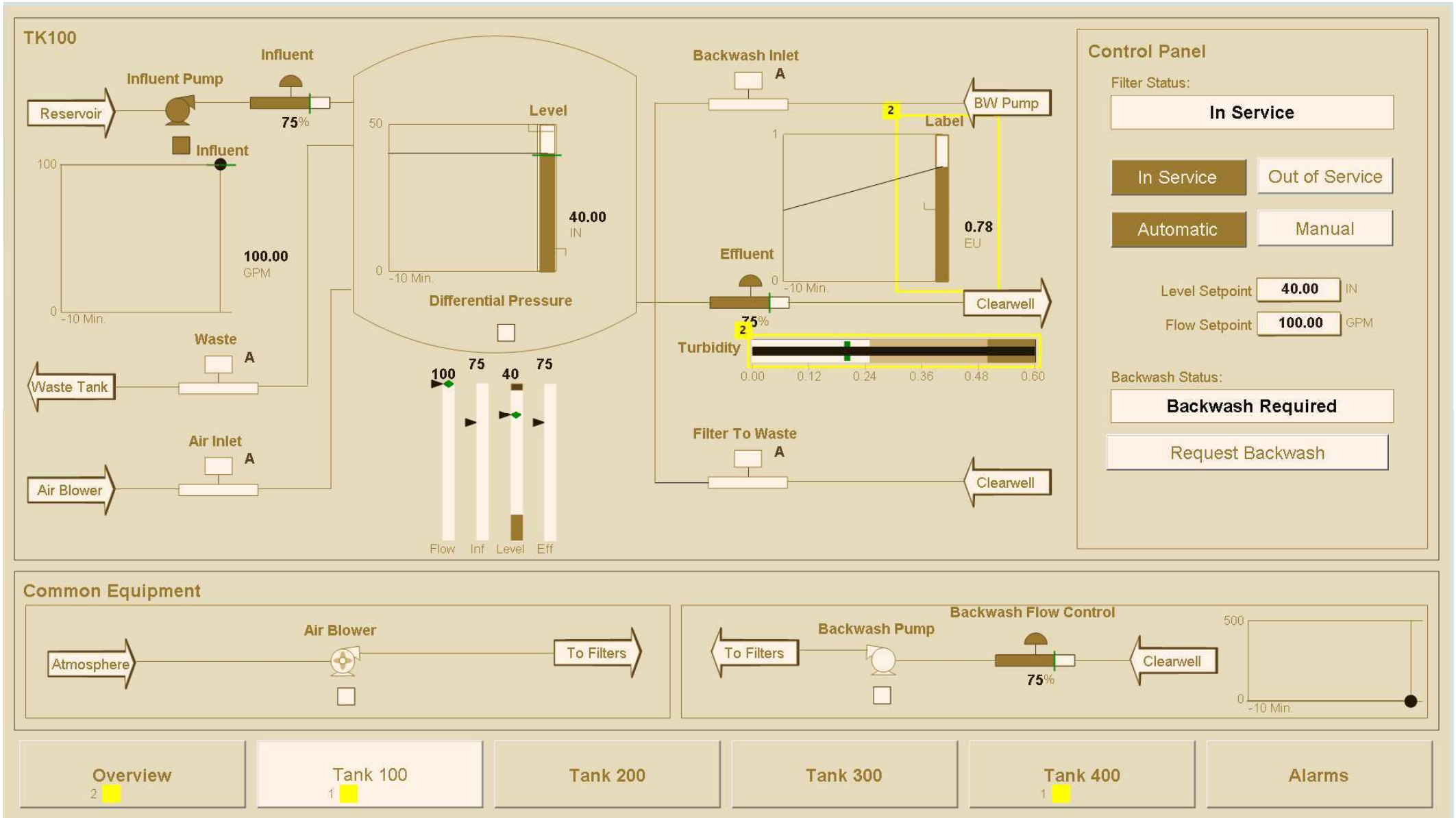
vel is Low

vel is High

Tempest
IT makes sense

Wonderware – Situational Awareness

*Wonderware knižnica pripravená na použite – **príklady implementácie***

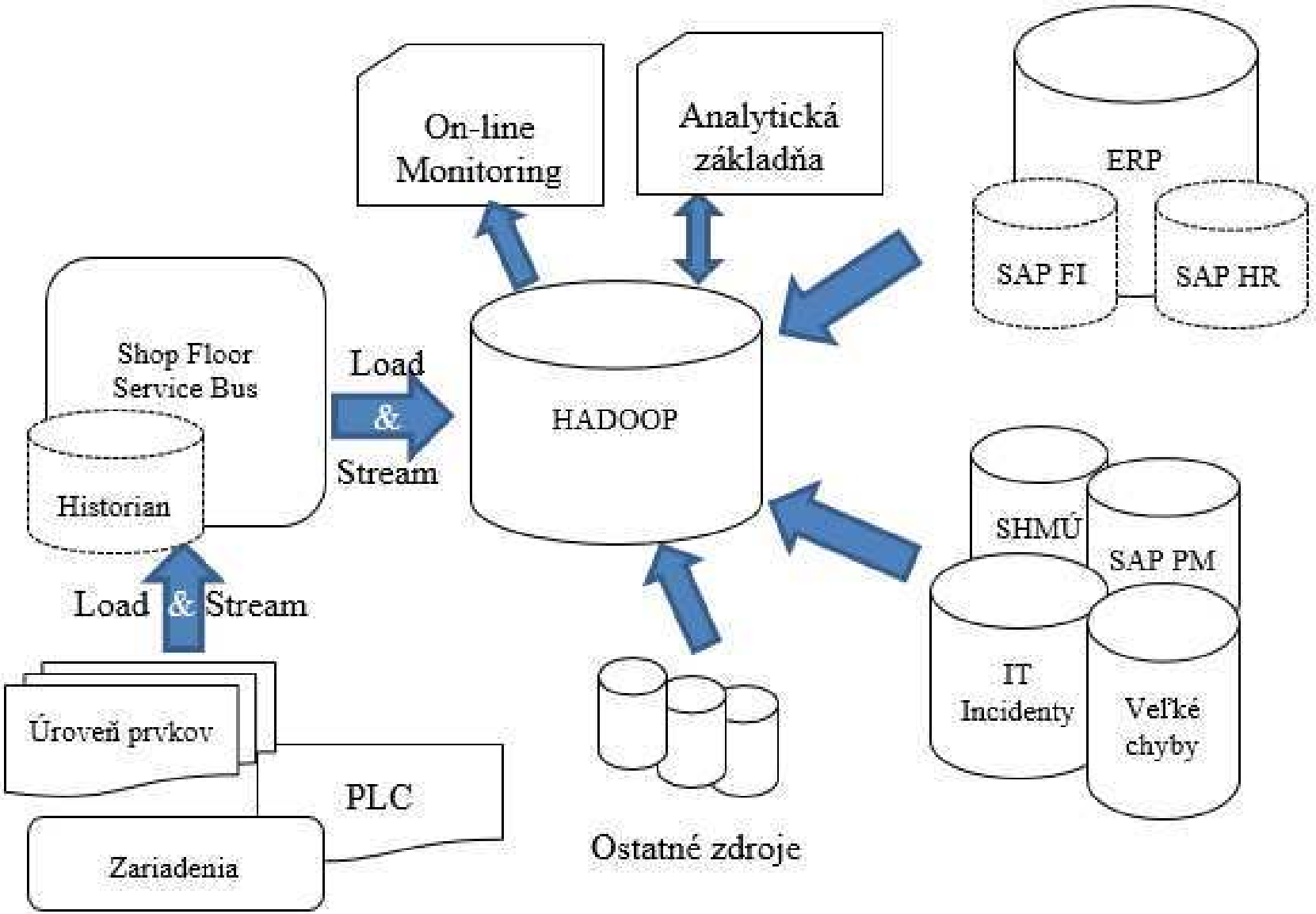


Vvyužitia data miningu - prípadová štúdia

Kvalita výrobkov, Chyby zariadení, Plánovanie údržby

- identifikácia vplyvu výrobných parametrov na celkový výrobný proces
- optimalizácia systémových a prevádzkových nastavení strojov
- optimalizácia výrobného procesu
- optimalizácia intervalov kontroly zariadení
- detekcia chybových stavov zariadení
- identifikácia neočakávaných výpadkov zariadení
- zabezpečenie kvality produkcie
- predikcia údržby strojov
- predikcie optimálnych cyklov výmeny častí strojov
- predikcia spotreby spotrebného materiálu
- predikcia chýb vo výrobe

Návrh analytickej platformy pre Big Data zohľadňujúceho koncept Industry 4.0



Zdroje dát

1. Lakovacie chyby z lakovne
2. Procesné dáta z MES (Wonderware) systému
3. Dáta zo SHMÚ

Obdobie	Počet záznamov	Záznamy bez duplikácií	Finálny počet záznamov
1.1.2016 – 31.12.2016	1 360 967	1 099 264	1 097 675
1.9.2016 – 31.12.2016	486 117	385 358	384 480

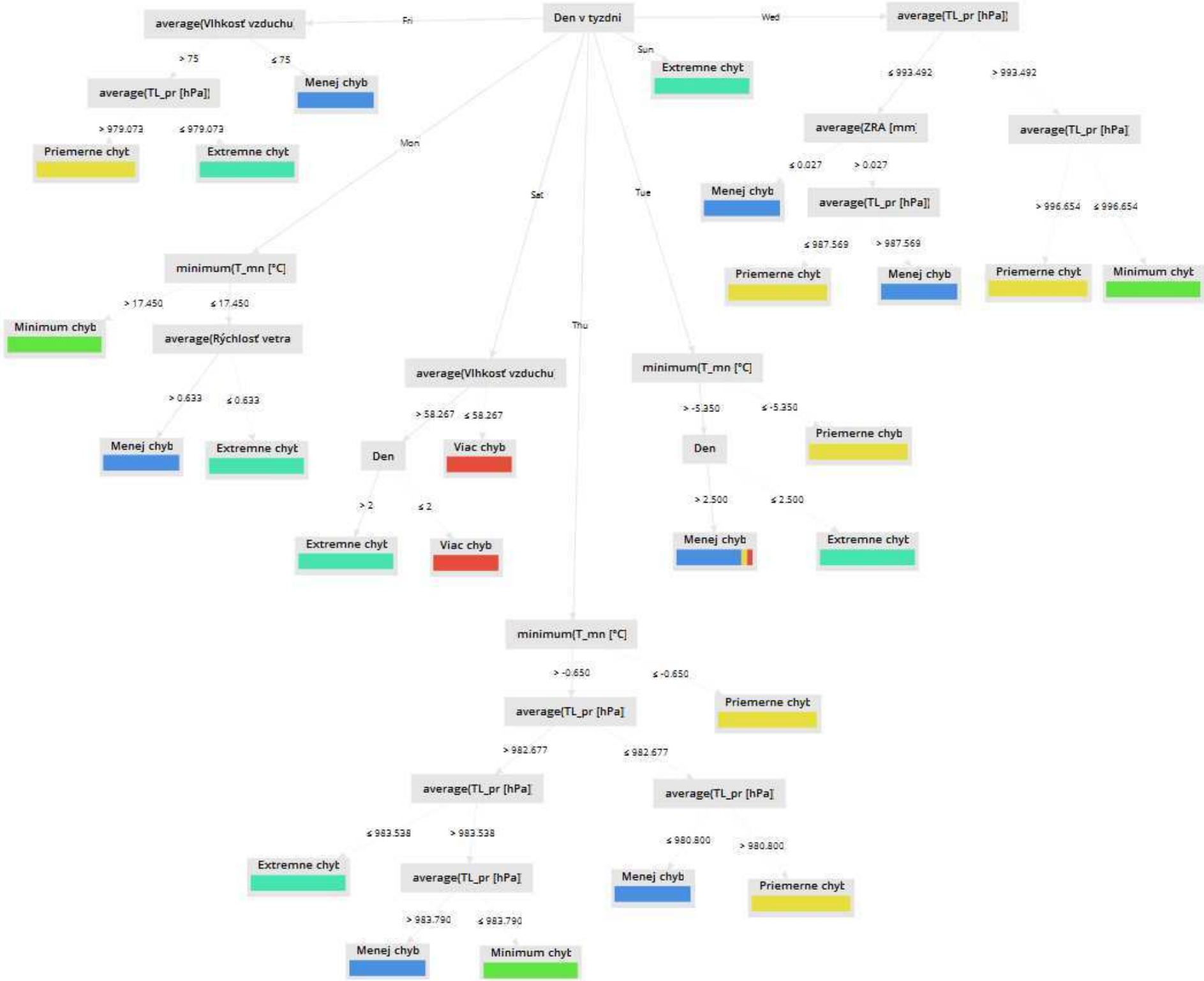
Vytvorené štatistiky s hypotézami:
Závislosť pracovných zmien, dňa v týždni a hodiny na vznik lakovacích chýb .

Návrh frameworku pre zber heterogénnych dát z lakovne, ich spracovanie, ukladanie a príprava pre získavanie znalostí z dát

Získavanie znalostí pre potreby riadenia výrobných procesov s využitím vybraných metód a nástrojov pre analýzu dát získaných z lakovne

Rozhodovacie stromy

Presnosť modelu	Manuálny výber atribútov					Atribúty podľa váhy				
	Neoptimalizované parametre rozhodovacieho stromu				Optimalizované parametre	Neoptimalizované parametre rozhodovacieho stomu				Optimalizované parametre
	Gain ratio	Inform. gain	gini_index	accuracy		Gain ration	Inform. gain	gini_index	accuracy	
Manuálny výber hodnoty cieľ. Atribútu	70,91	70,91	72,73	76,36	**79,09**	72,73	70,91	71,82	75,45	**79,09**
Discretize by Binning	69,09	70,00	67,27	70,00	**80,00**	68,18	68,18	70,00	73,64	**80,91**
Discretize by Frequency	46,36	44,54	47,27	46,36	56,36	48,18	46,36	44,55	51,82	59,09


Den v tyzdni
Fri
average(Vlhkosť vzduchu
> 75
≤ 75
average(TL_pr [hPa]]
Menej chyb
> 979.073
≤ 979.073
Priemerne chyt
Extremne chyt
Mon
minimum(T_mn [°C]
> 17.450
≤ 17.450
Minimum chyb
average(Rýchlosť vetra
> 0.633
≤ 0.633
Menej chyb
Extremne chyt
Sat
average(Vlhkosť vzduchu
> 58.267
≤ 58.267
Den
Viac chyb
> 2
≤ 2
Extremne chyt
Viac chyb
Thu
minimum(T_mn [°C]
> -0.650
≤ -0.650
average(TL_pr [hPa]
Priemerne chyt
> 982.677
≤ 982.677
average(TL_pr [hPa]
average(TL_pr [hPa]
≤ 983.538
> 983.538
Extremne chyt
average(TL_pr [hPa]
> 983.790
≤ 983.790
Menej chyb
Minimum chyt
Tue
minimum(T_mn [°C]
> -5.350
≤ -5.350
Den
Priemerne chyb
> 2.500
≤ 2.500
Menej chyb
Extremne chyt
Sun
Extremne chyt
Wed
average(TL_pr [hPa]]
≤ 993.492
> 993.492
average(ZRA [mm
average(TL_pr [hPa]
≤ 0.027
> 0.027
Menej chyb
average(TL_pr [hPa]]
≤ 987.569
> 987.569
Priemerne chyt
Menej chyb
> 996.654
≤ 996.654
Priemerne chyt
Minimum chyt

Získavanie znalostí pre potreby riadenia výrobných procesov s využitím vybraných metód a nástrojov pre analýzu dát získaných z lakovne

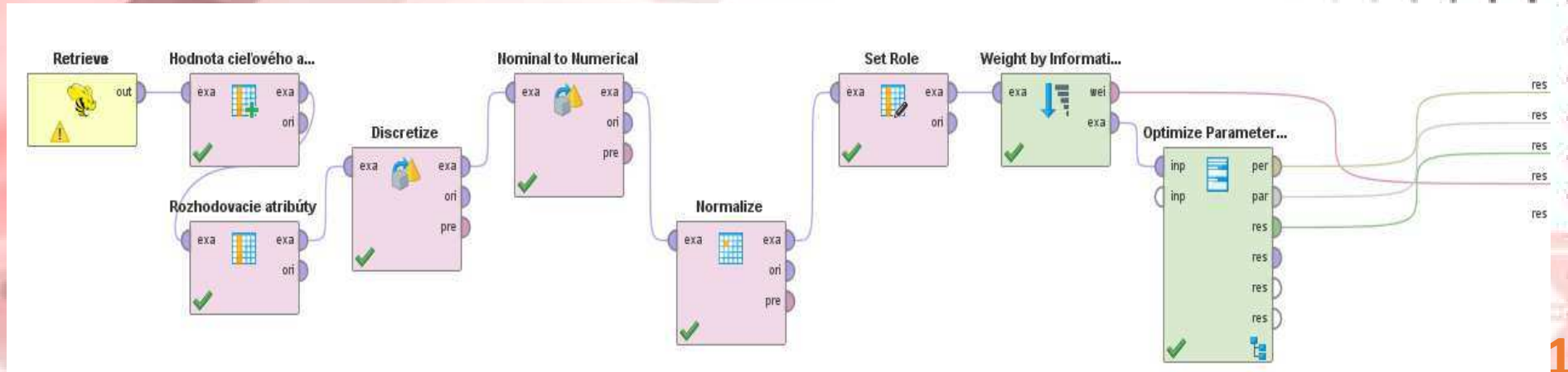
Rozhodovacie stromy

Algoritmus	Hodnota presnosti	Klasifikačná chyba	Kappa	Absolútna chyba	Korelácia
Decision Tree	80,91%	19,09	0.639	0.279	0.859
Random Forest	80,91%	19,09	0.622	0.409	0.845
Gradient Boosted Tree	77,27%	22,73	0.638	0.744	0.842
C4.5	82,73%	17,27	0.670	0.428	0.855
Random Tree	82,73%	17,27	0.639	0.300	0.770
ID3	81,82%	18,18	0.306	0.306	0.842

Získavanie znalostí pre potreby riadenia výrobných procesov s využitím vybraných metód a nástrojov pre analýzu dát získaných z lakovne

Neurónové siete

Typ neurónovej siete	Presnosť modelu	Kappa	Korelácia
Neural nets	82,73%	0.652	0.860
AutoMLP	80,00%	0.601	0.841
Deep learning	81,82%	0.639	0.851



Ďakujem za pozornosť

vladimir_surka@tempest.sk

ORGANIZING THE COLLABORATION BETWEEN UNIVERSITIES AND SME'S

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Universities, SME's and Knowledge Management (S2)

Vysoká škola manažmentu v Trenčíne

International Workshop on Knowledge Management
IWKM'2017

Trenčín 12 - 13. 10. 2017

Collaboration of Knowledge Workers

P. Drucker:

The knowledge worker cannot be supervised closely or in detail. He can only be helped.

But he must direct himself, and he must direct himself towards performance and contribution, that is, toward effectiveness.

What sorts of help are critical?

- Connecting relevant individuals
- Building working conditions for them
- Appreciating their efforts

Connecting Relevant Individuals

- Not necessarily the top managers – rather those directly involved
- SME: those responsible for development
- University: those interested in applications and knowledge distributions

Building working conditions

- Finding appropriate topic:
  - Design/development of a product
  - Creative marketing
  - Training of staff
  - …

Appreciating Efforts of Collaborating Team

- Promote entrepreneurial culture
- Identify key individuals
- Modify the assessment culture
- Be fair and open

System dynamics tools
Archetypes in Management

Universities, SME's and Knowledge Management (S2)

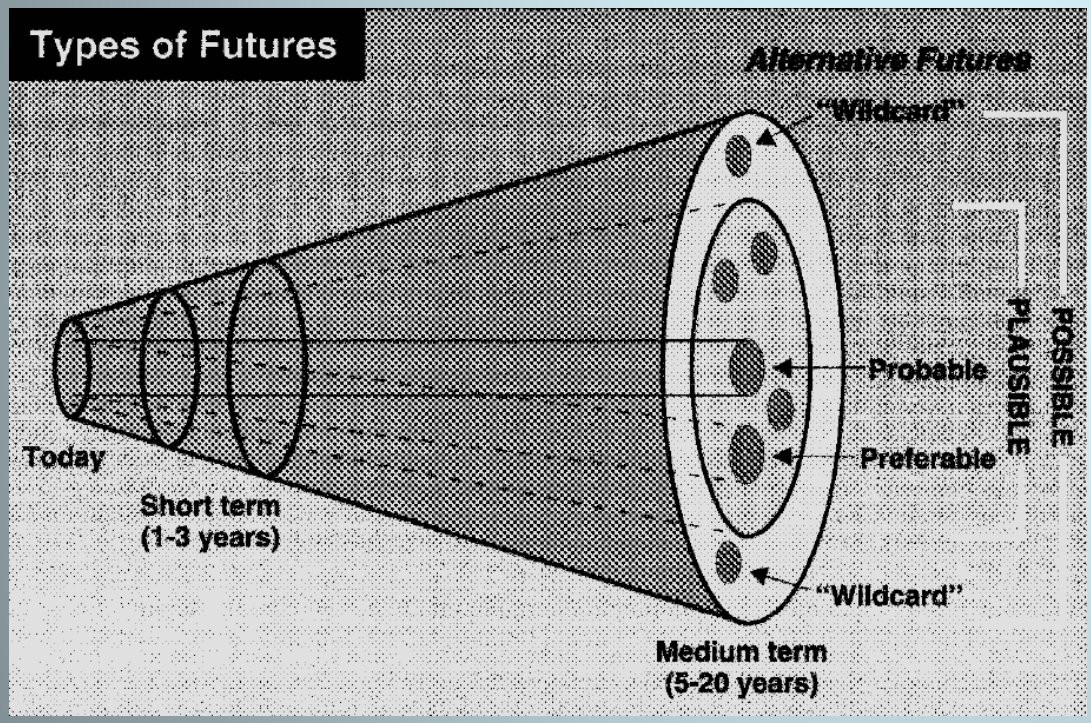
Vysoká škola manažmentu v Trenčíne
International Workshop on Knowledge Management
IWKM'2017

Trenčín 12 - 13. 10. 2017

Fridrich Rácz

Seeing Beyond the Probable

"Most organizations plan around what is most likely.
In so doing they reinforce what is, even though they want something very different."
(Clement Bezold)



- **Possible**

What may happen?

- **Plausible**

What could happen?

- **Probable**

What will likely happen?

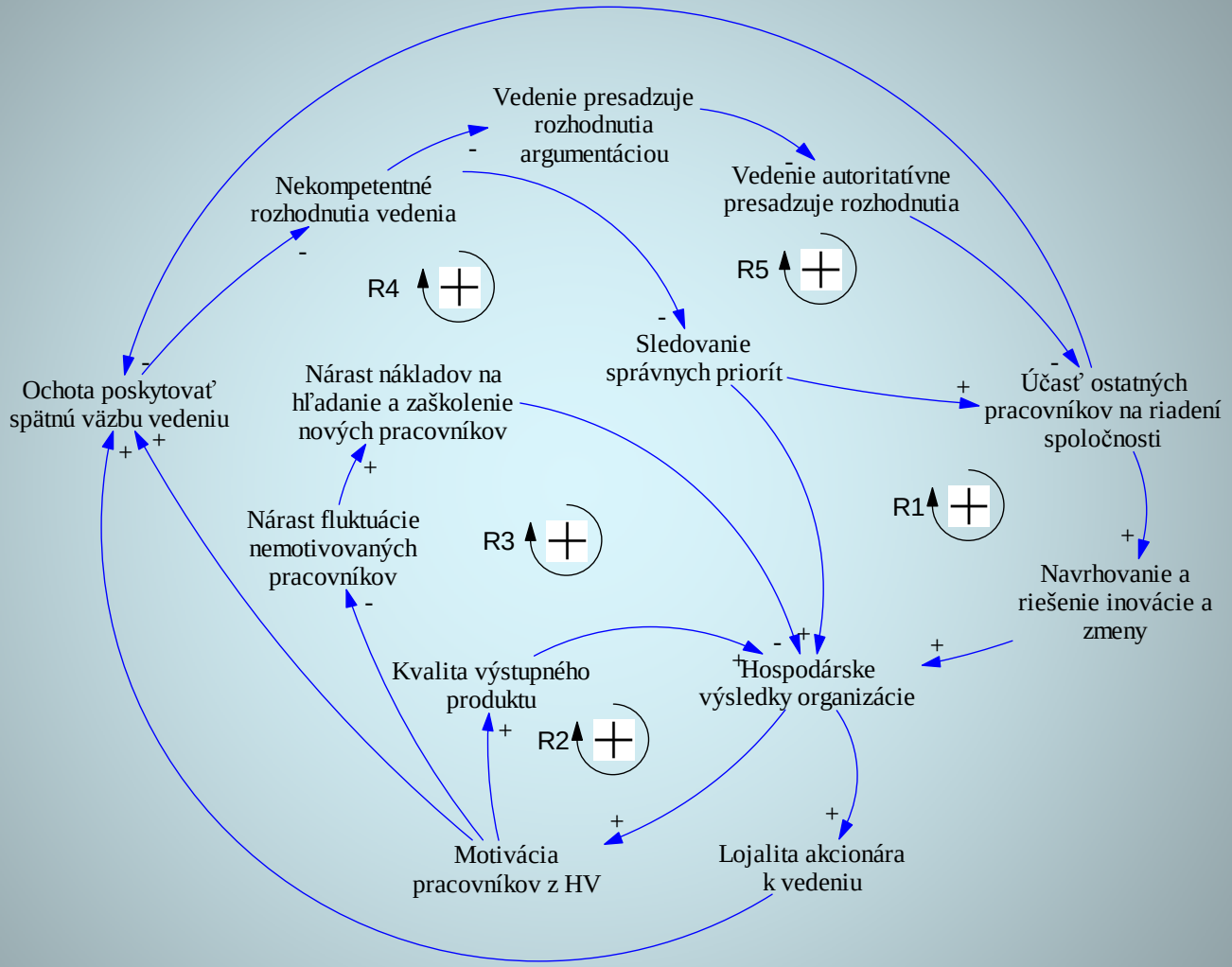
- **Preferable**

What do we want to have happen?

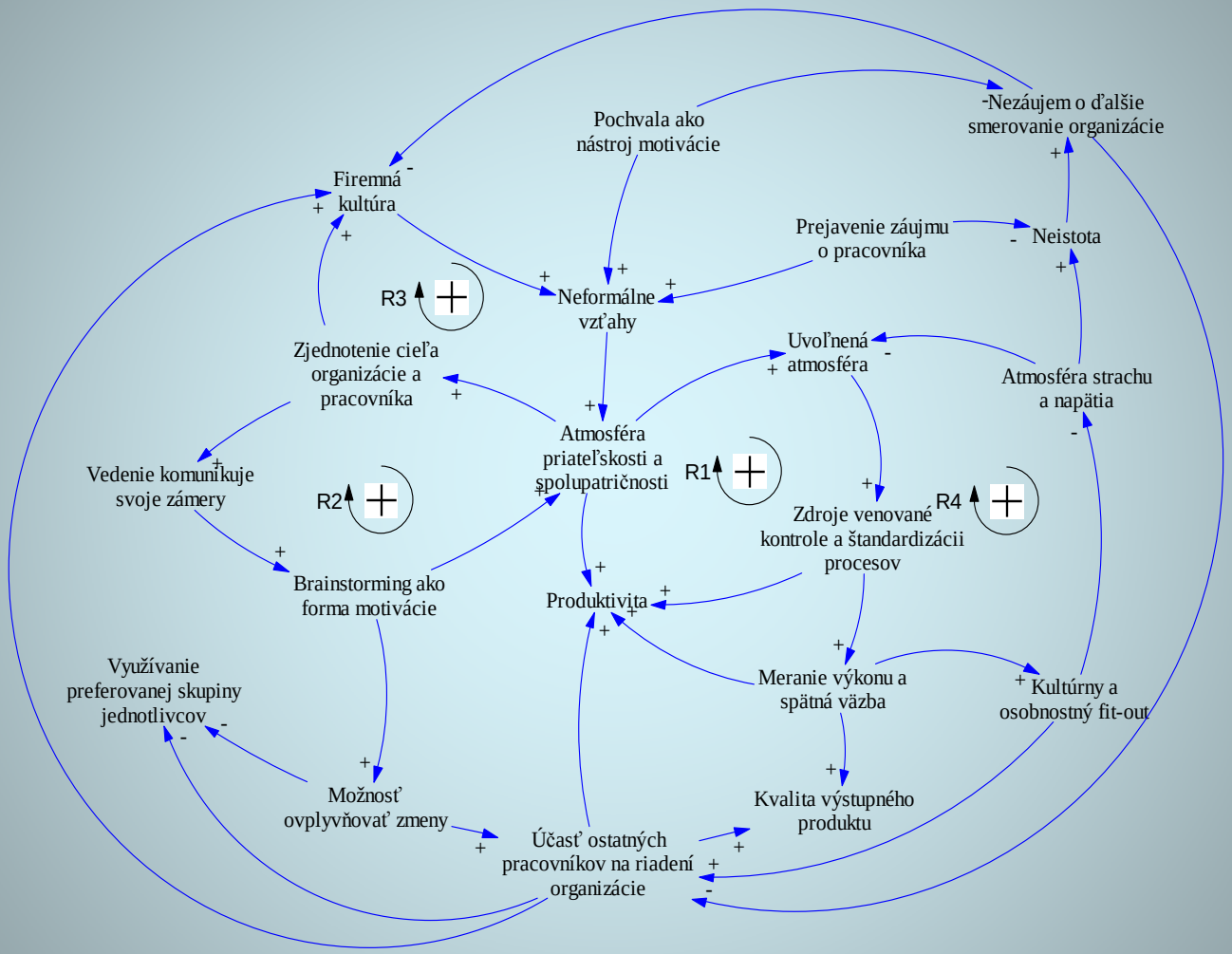
System Dynamics

- System dynamics is an approach to understanding the behavior of complex systems over time
- System dynamics is a methodology and mathematical modeling technique for framing, understanding, and discussing complex issues and problems
- The elements of system dynamics diagrams are feedback, accumulation of flows into stocks and time delays
- The continuous view strives to look beyond events to see the dynamic patterns underlying them

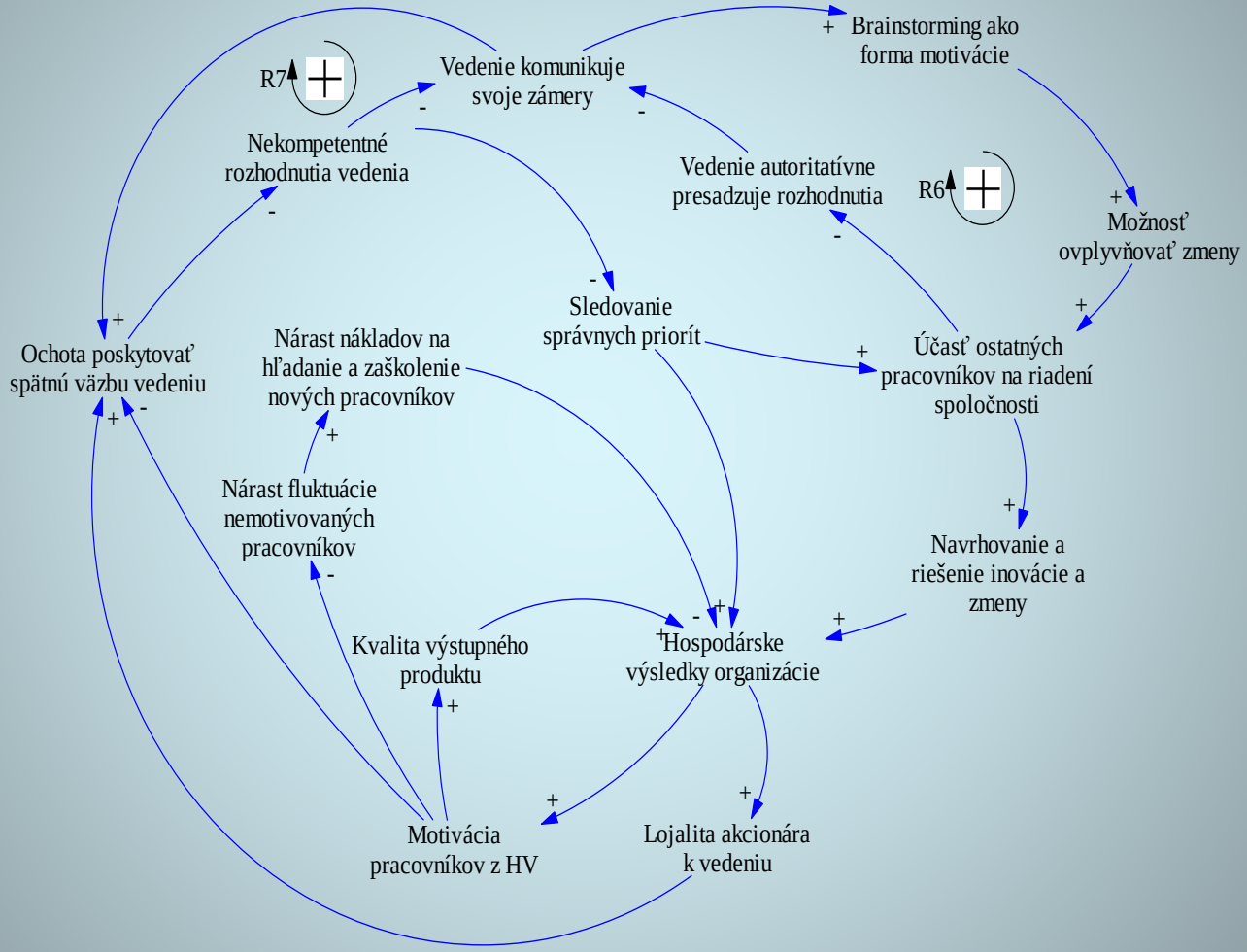
CLD Incompetent Leaders



CLD Motivation

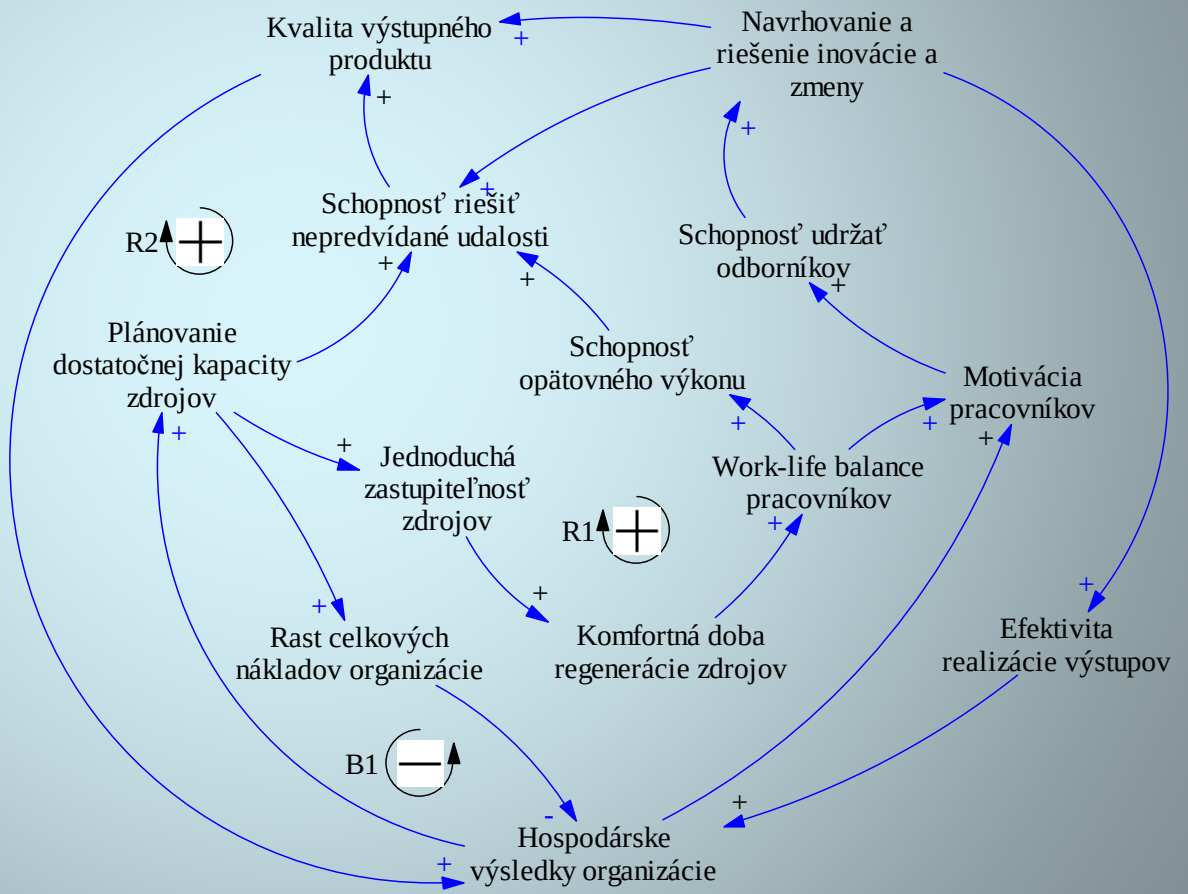


CLD Incompetent Leaders – revised and alterned with CLD Motivation



Dilema

- **Resources**
- **Processes**
- **Quality**



Archetypes in Management

- It is possible to describe complexity in various relations by CLD
- It was proven that archetypes can be identified in stereotypical behavior of organizations
- CLD are usable tool for externalization of tacit knowledge

Thank you for your attention

Education 4.0

Is there a synergy between Industry 4.0 and Education?

Mgr. Michal Rosík
(Minit j.s.a., michal.rosik@minit.io)

Seminar on Universities, SME's and Knowledge Management (S2)

Vysoká škola manažmentu v Trenčíne

International Workshop on Knowledge Management
IWKM'2017

Trenčín 12 - 13. 10. 2017

It all started with…

VSM (City University)

Personalized University

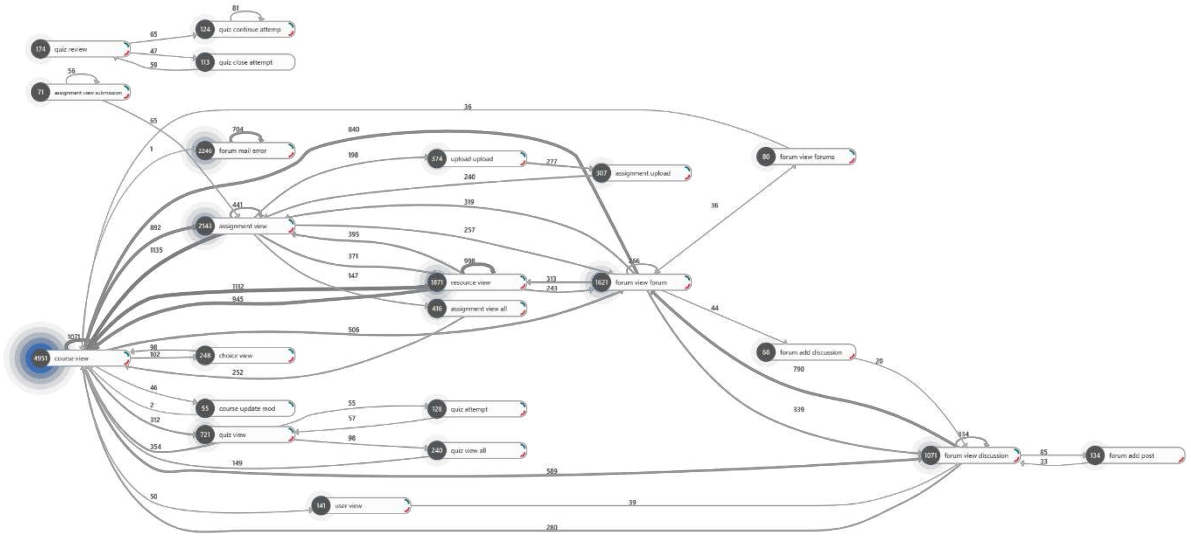
Analytical Results

- Comparing A & B grade students to E graders
- 7 activities revealed in their flow
- Rising activity by 50% and redistributing in time

Outcome

- Easier student onboarding
- Best practice guide

Phase 1

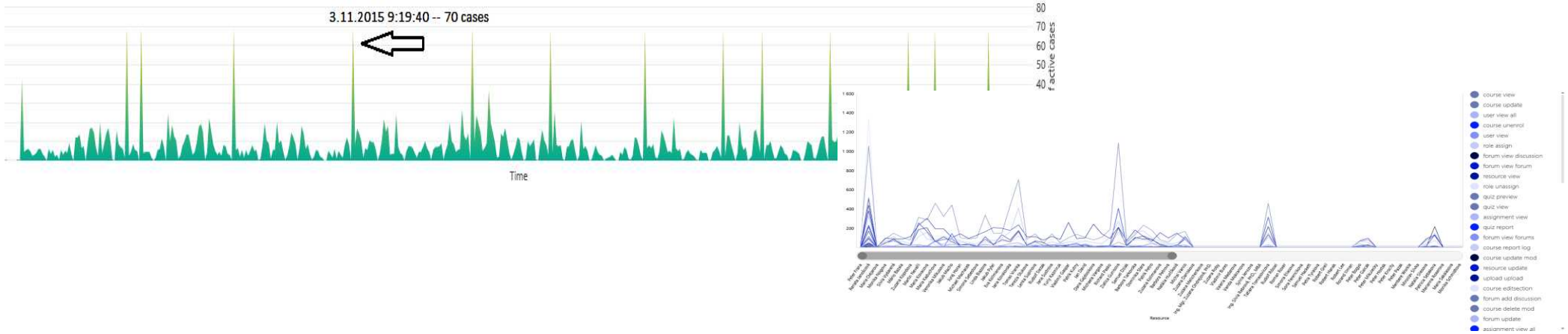


Info

2. ZADANIE	175	70%
AKTIVITA 2 (denní študenti)	48	19%
1. ZADANIE	24	10%
AKTIVITA 1 (denní študenti)	4	2%

Info

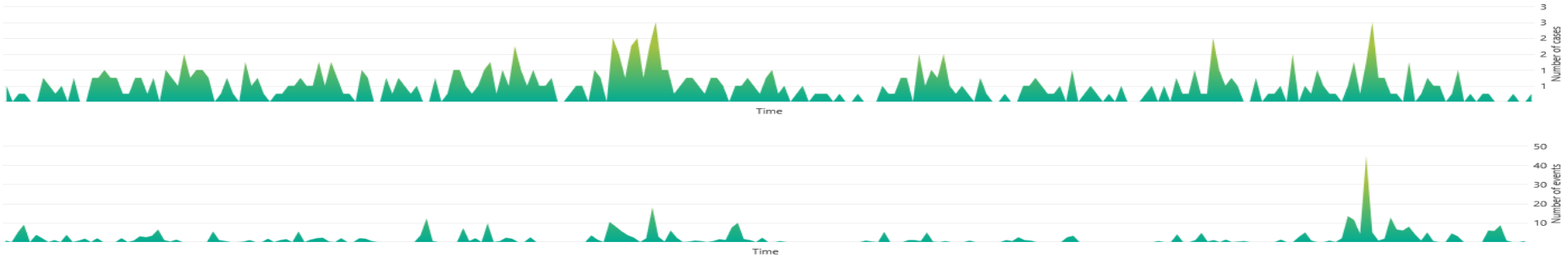
PRÍKLAD č.1	34	17%
PRÍKLAD č.2	30	15%
V 4. týždni NEZABUDNITE! - v utorok - uče	23	11%
Príklad 2	20	10%
Príkald 1	18	9%
PRÍKLAD č.3	11	5%

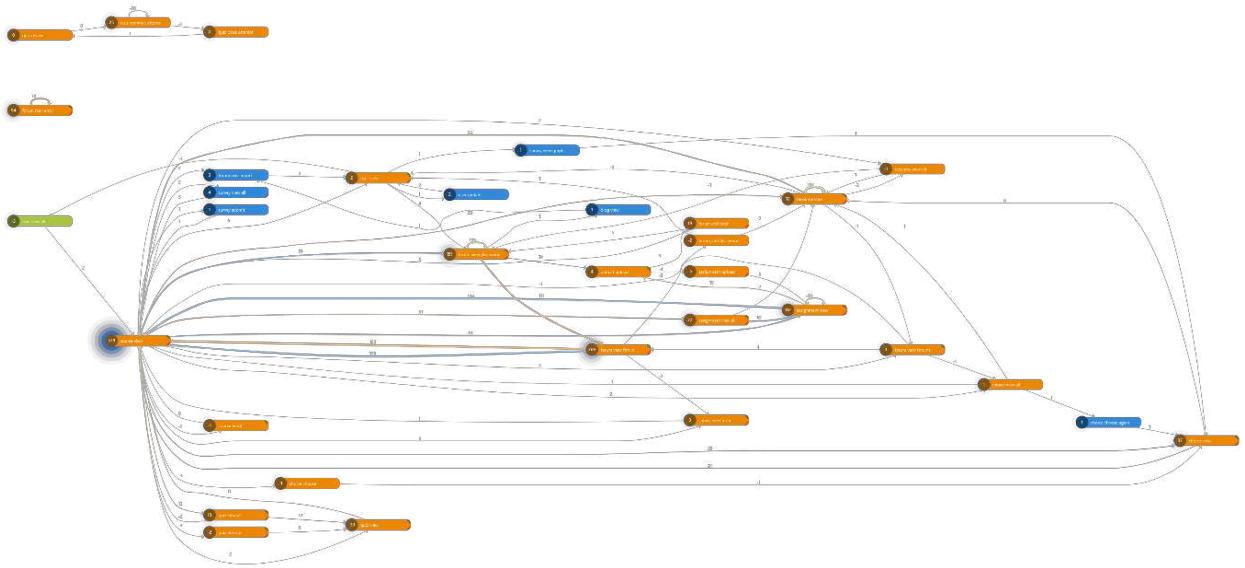


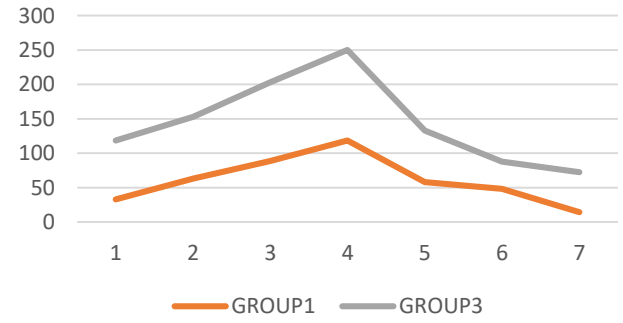
Further questions

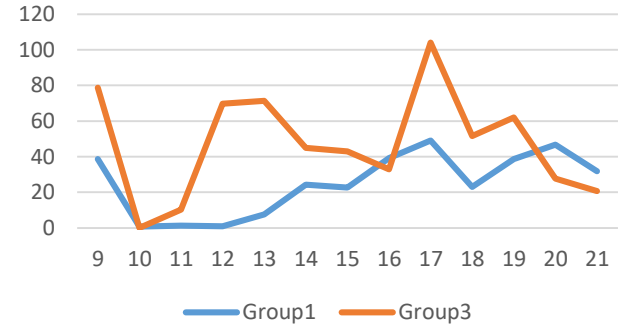
- Can we focus on a specific study field?
- Are we able to enrich the data with final grades and thus distinguish students?
- Are we able to distinguish the process variants and habits of best performers?
- And what about comparisons to low performers?
- Would it be possible to learn from the best and guide newcomers to achieve better final grades?

Phase 2

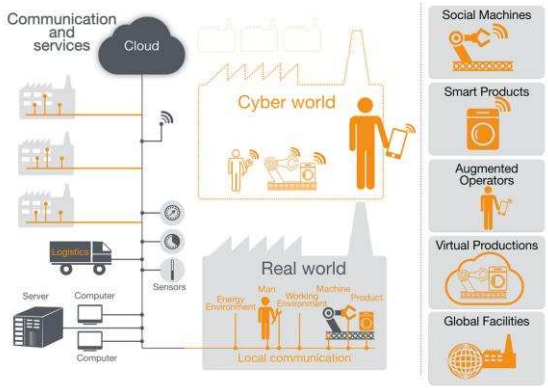

Time
Number of cases
Time
Number of events

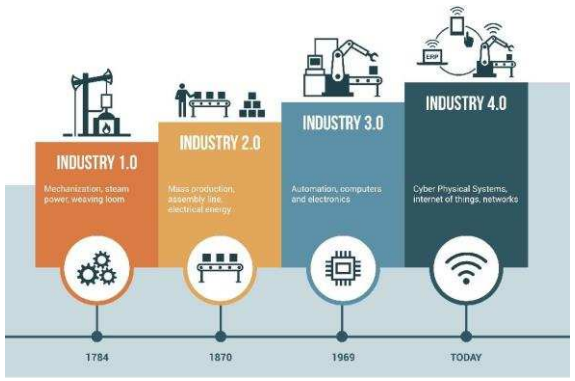


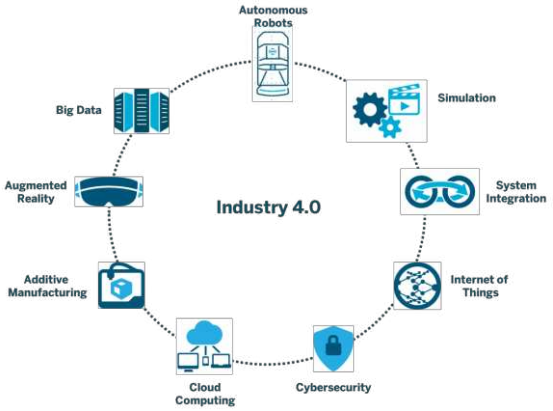

300
250
200
150
100
50
0
1
2
3
4
5
6
7
GROUP1
GROUP3

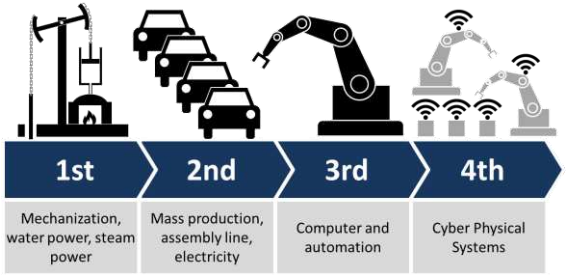

120
100
80
60
40
20
0
9
10
11
12
13
14
15
16
17
18
19
20
21
Group1
Group3

What else can be done?









Industry 4.0

Resource: https://en.wikipedia.org

Cyber-physical systems

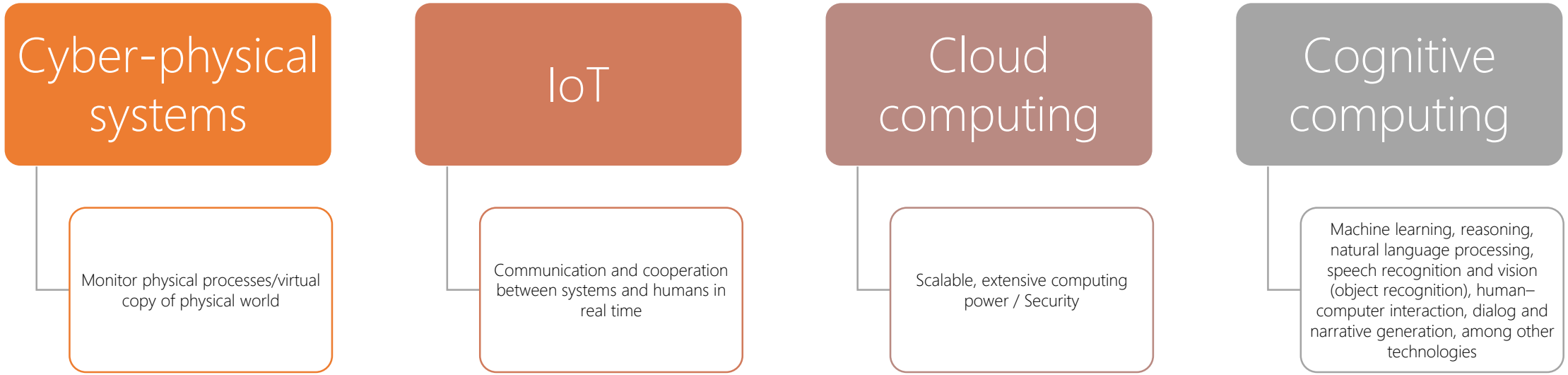
IoT

Cloud computing

Cognitive computing

Industry 4.0

Resource: https://en.wikipedia.org



Industry 4.0

Resource: https://en.wikipedia.org

01

Connection
(sensor and networks)

02

Cloud
(computing and data on demand)

03

Cyber
(model & memory)

04

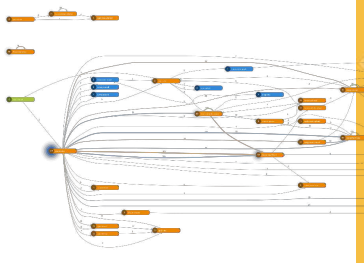
Content/context
(meaning and correlation)

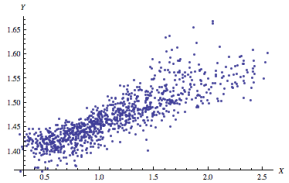
05

Community
(sharing & collaboration)

06

Customization
(personalization and value)





6C of BigData Analytics in EDUCATION 4.0

Resource: https://en.wikipedia.org

THANK YOU

Michal Rosik

PRODUCT VISIONARY

As Product Visionary for minit, Michal defines the Research & Development direction for this process mining solution, develops close ties to the academic community in this area and evangelises process mining benefits to enterprises worldwide. Michal previously lead Microsoft Consulting department in Siemens and was involved in several large enterprise projects as a consultant and project manager. In his free time, he is a passionate trail runner.

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Entrepreneurial University

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Universities, SME's and Knowledge Management (S2)

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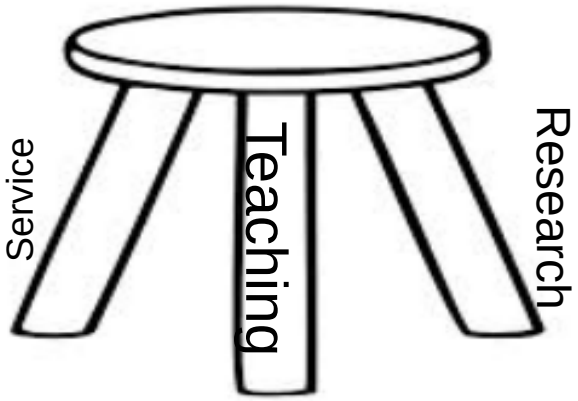
Old Model of Universities



- **First Mission**: Teaching - Bologna in 1088: “University" is derived from the Latin - *universitas magistrorum et scholarium*, which means "*community of masters and scholars*
- **Second Mission***: 1900’s First Academic Revolution - Research*
  - *A*gricultural extension programs - Encouraged faculty to conduct research that could be translated into practice.

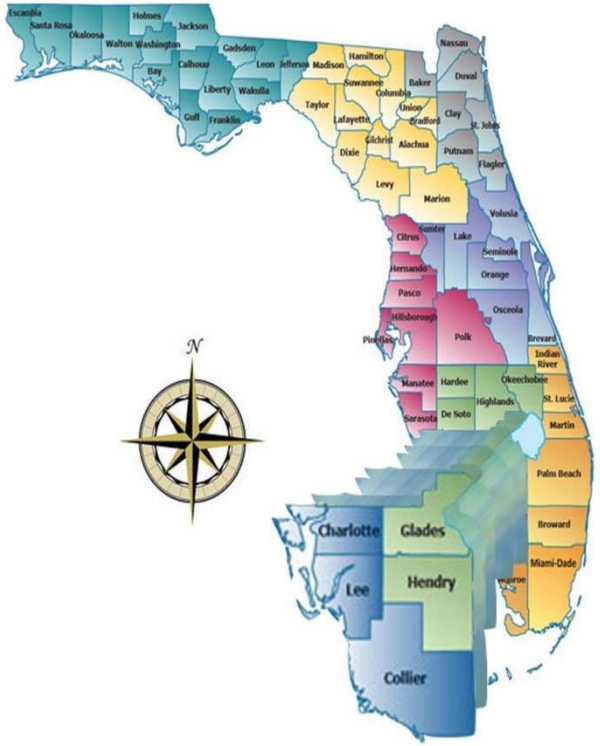


New Model: Entrepreneurial University

- **Third Mission**: 1980's: Second Academic Revolution (internal/external)
  - External Service – Entrepreneurial University (Academic Capitalism)
  - Triple Helix Model: Industry and government, works with academia in contributing to innovation-driven strategy aimed at regional or national economic growth strategy (third stream activities that exploit knowledge)
  - Bayh-Dole Act (Patent and Trademark Laws); Employed Inventor Act, etc.
  - U.S., Europe, Asian; Technology Transfer, Spin-offs, Knowledge Exchange, etc.
- **Fourth Mission**: "Now" – Co-creation for Sustainability
  - Not only contribute to economic and social development via technology transfer and entrepreneurialism, but also collaborates with different stakeholders with the aim of materialising sustainable development.

Florida Gulf Coast University

- State University
  (10th SUS; Teaching and Research)
- Founded: August 1997
- Current: 15,000 plus students
  Growth: 25,000 plus (7 yrs)
- Lutgert COB Largest College
- B.S, MBA, MS, EMBA, Int.
- UG – Traditional
- MBA – Traditional/
  Non-Traditional

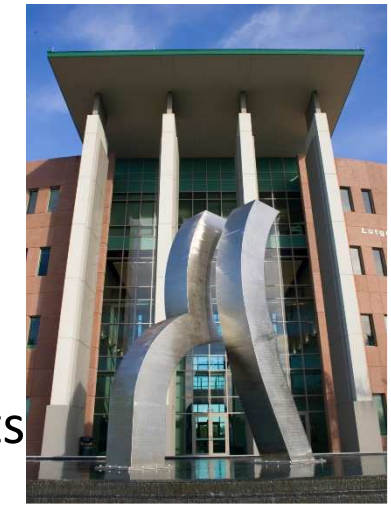


Lutgert College of Business
Center for Leadership & Innovation

Founding Principles

- Extension of College and formed before University opened
- Strategically located between primary services areas
- Created partnerships with Public, Private and Corporate Communities
- Provided link between college and universities resources and Economic Development
- Broke down old barriers between university and community

Centers' and Institutes

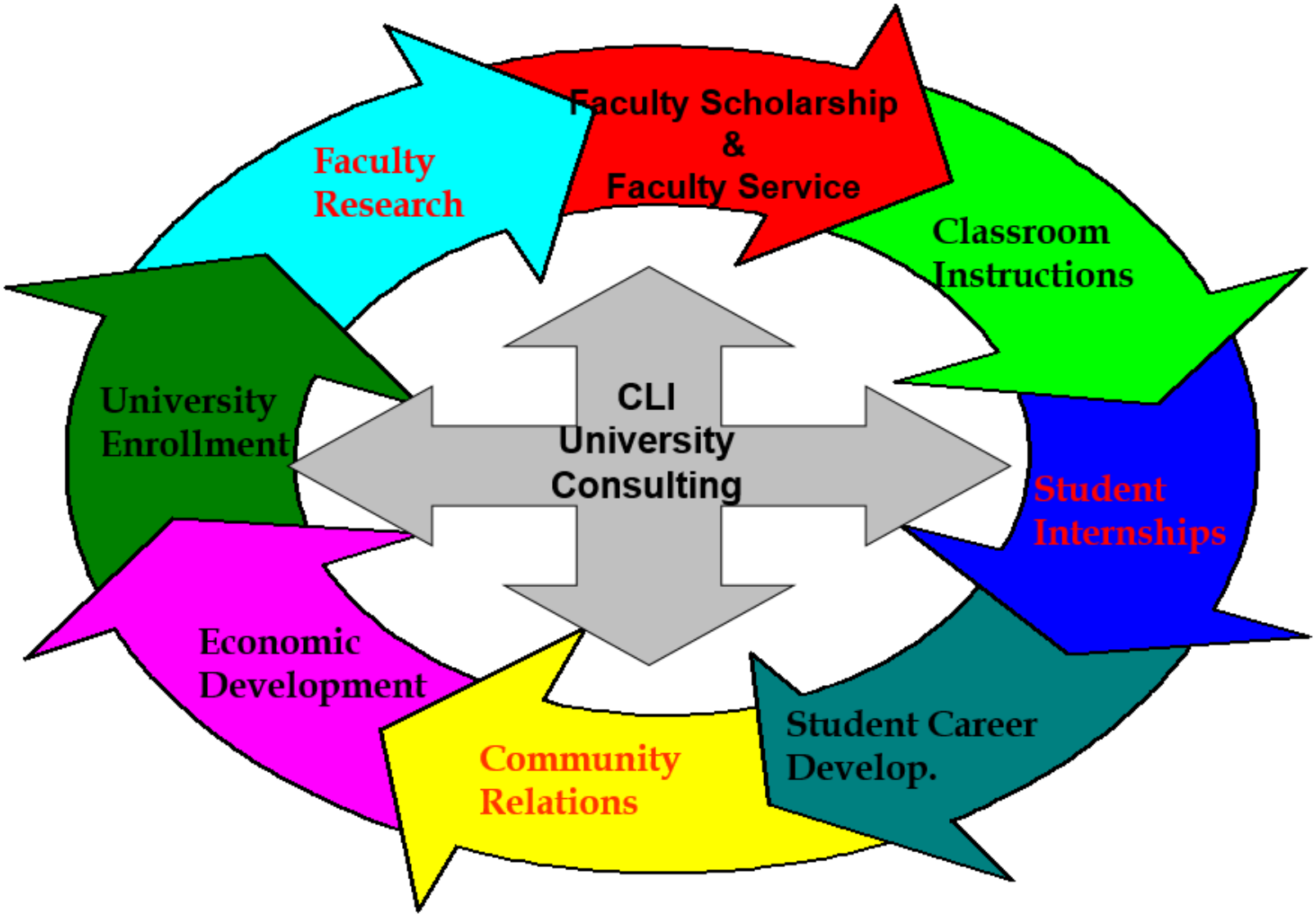


- Executive MBA Program; Lucas Institute for Real Estate Development and Finance; Small Business Development Center;
- Institute of Chinese Studies and Emerging Markets
- Regional Economic Research Institute; Center for Conflict Resolution; Economic Education; Inst. H.R; Sponsored Projects

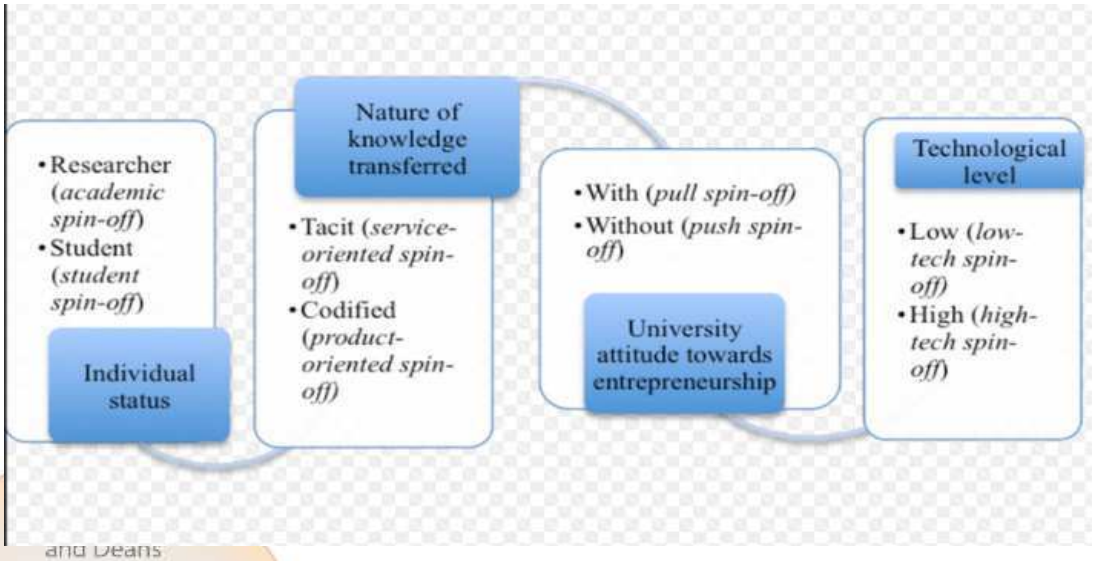
- Professional Workshops, Seminars, Conferences, Forums; and Comprehensive Training Assistance, Professional Certification Training Programs, Specialized In-house Training, etc.
- Research and Consultative Services

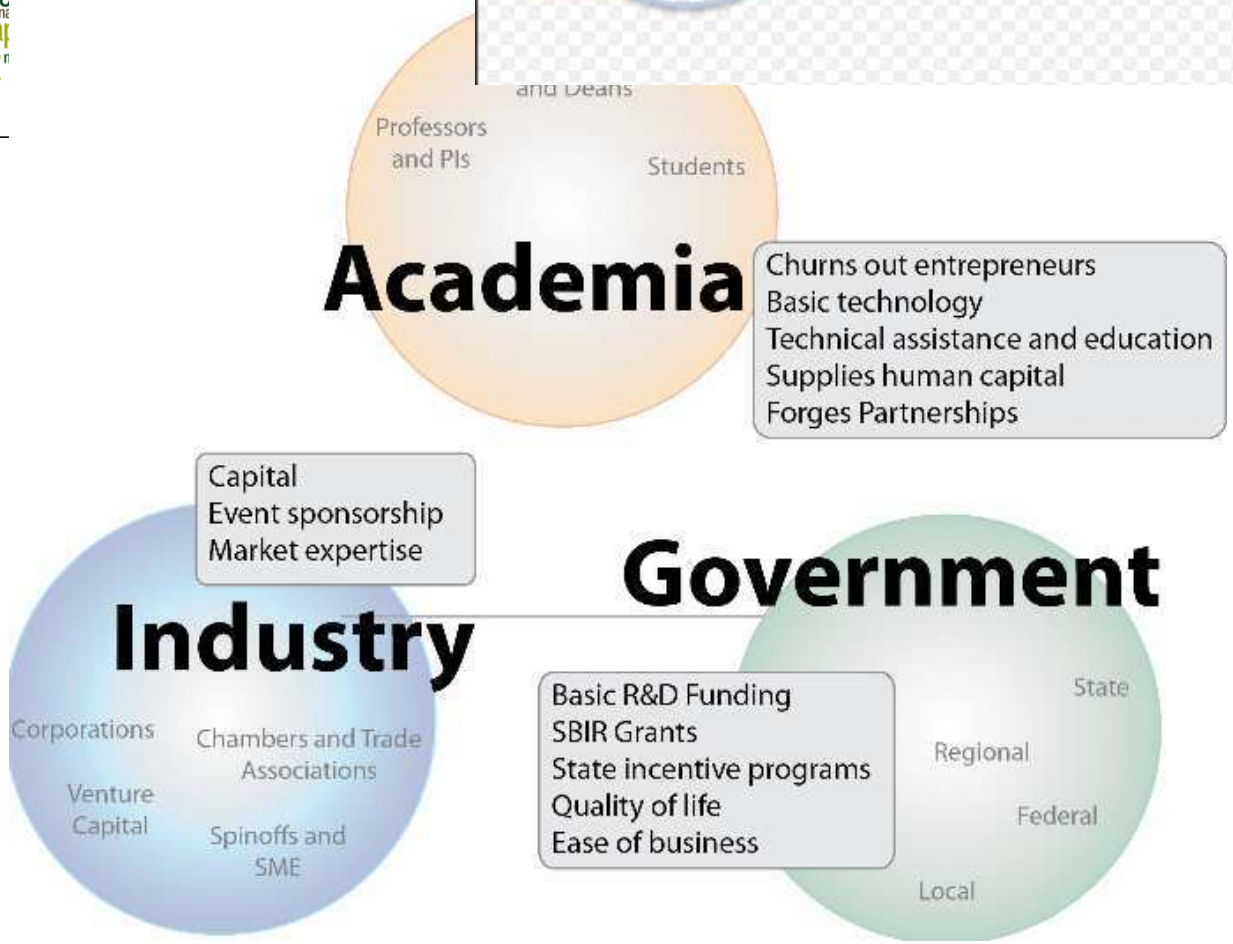
✓Comprehensive Organization Wide Assessment
✓Focus Groups and Nominal Grouping Sessions
✓Employee and Customer Satisfaction Surveys
✓Human Resource Systems (Development and Assessment)
✓Public Surveys (Community, Business Community, etc)
✓Comparative Benchmark Assessments
✓Strategic Planning and Strategic Facilitation
✓Economic Impact Studies
✓Individual and Group Leader Training
✓Myers Briggs Type Indicator (MBTI) Assessment
✓Quality Assessment and Process Mapping
✓Business Plan Development
✓Development of Information Databases
✓Web Based Development
✓Work-Life Balance Survey
✓360 Benchmarking of Executive Team

Benefits to University



Entrepreneurial University

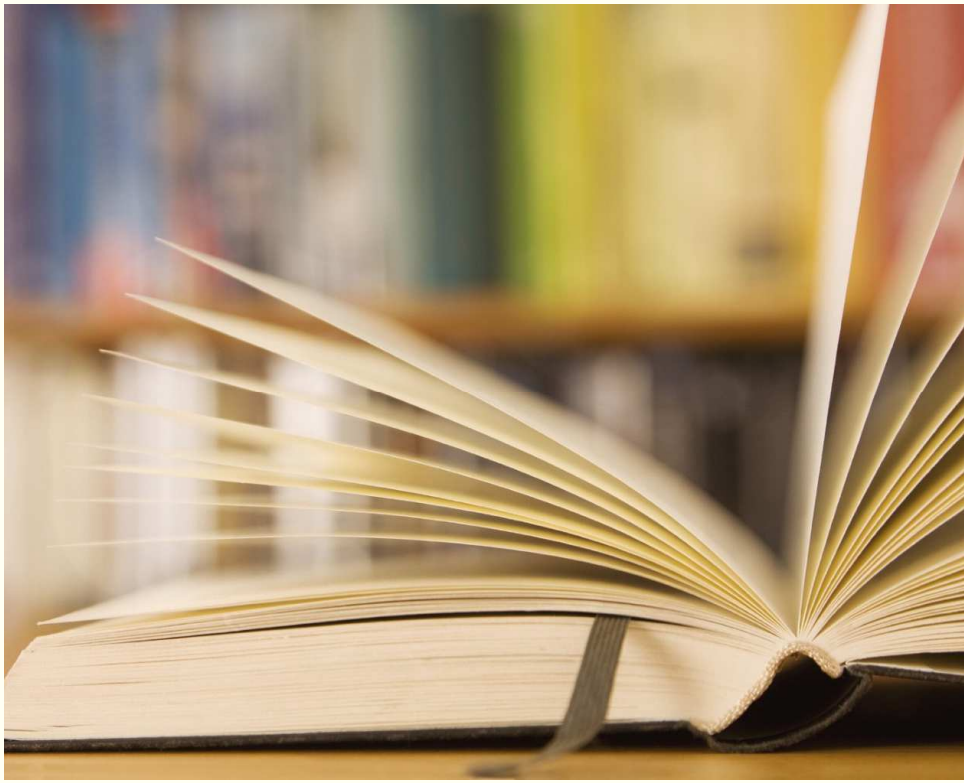




COLLABORATIVE LEARNING

Lenka Šablatúrová

Universities, SME's and Knowledge Management (S2)



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Key points

- Company education
- Gamification courses
- Coaching and Mind mapping
- Tailored educational product
- Educational strategy
- Self-directed education
- Passion-driven learning
- Life-long learning

Answers

Tailored Educational Product

Question 1:

Target group?

Comparison of the students

	Traditional students	Adult students
Origin of the previous knowledge	Previous academic study	Study and professional experience
Key knowledge characteristics	Systematic, theory oriented	Practical, significantly less systematic
Motivation	Degree, diploma	Career, promotion
Work experience	Minimum	Several years
Command of the target subject of the study	Minimum, often none	Rich, depending on the work experience, however limited to the practical part of the subject

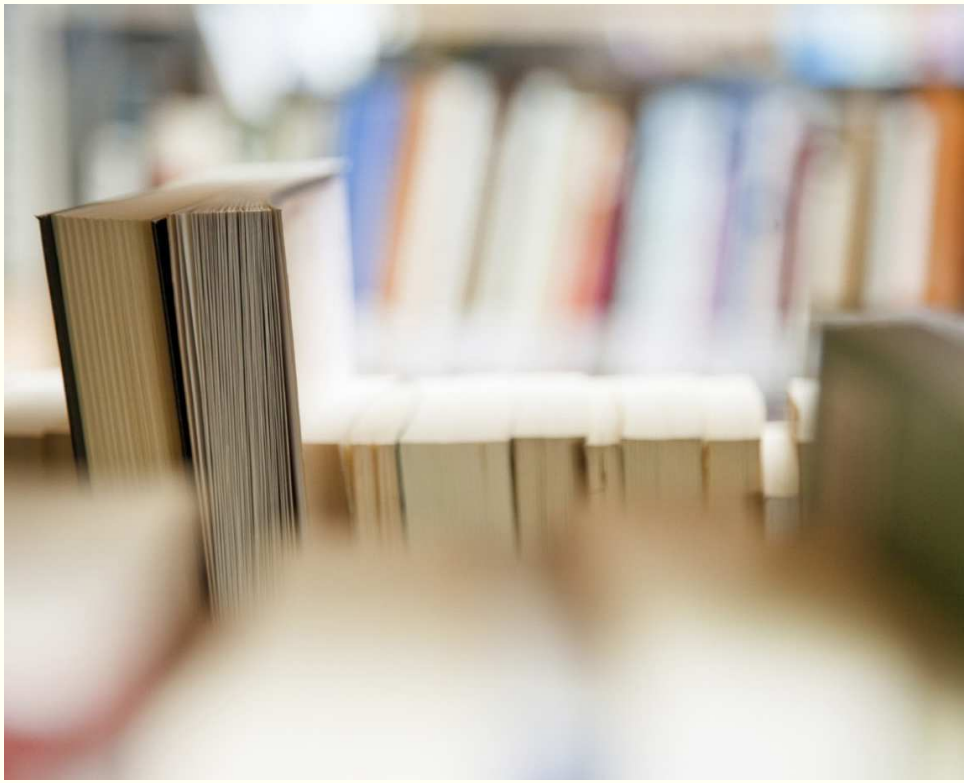
Tailored Educational Product

Question 2:

How to determine which pieces of knowledge does the student in our target group have, how to identify which pieces of knowledge he would like to have and how to map the differences with the aim to form the content of education?

THANK YOU!

LENKA SABLATUROVA
+421908668999



ISBN 978 – 80 – 89306 – 35 - 0