

# Innovative Business Analysis Curriculum for Computer Science, IT and Engineering Programs

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**Abstract**—The research focused on Business Analysis (BA) applications in industry clearly shows that companies and businesses will soon need a significant number of well educated and highly skilled business analysts in Information Technology (IT), Computer Information Systems (CIS), Computer Science (CS) and Engineering areas. Information Technology Business Analysis (ITBA) graduates and experts must be equipped with knowledge and skills with dual business and IT focus; particularly, they must obtain a traditional BA set of skills such as enterprise analysis, knowledge of main business functions, BA planning and monitoring, and deep knowledge of computer systems' analysis, design and integration, software and computer hardware systems, requirements engineering, IT infrastructure, IT management, and IT quality management. The findings and outcomes of performed analysis motivated the authors – faculty and graduate students of the Computer Science and Information Systems (CS&IS) Department at Bradley University (Peoria, IL, U.S.A.) - to work collaboratively, propose and design innovative academic curriculum – main topics, tools, courseware, lab practicum - in ITBA area for engineering education.

**Keywords**—*information technology; business analyst; innovative curriculum.*

## I. INTRODUCTION

In several upcoming years the BA experts will be in high demand by multiple large-size, middle-size and mostly small-size enterprises. “American employers will need 876,000 business analysis related professionals by 2020” U.S. industry will need 876,000 business analysis related professionals by 2020. ... A 19% growth is expected by 2022 in business analysis jobs” [1].

On the other hand, a demand for ITBA specialists in 2016 is clearly on the rise – about 34% of corporate respondents (i.e. managers in IT industry) “... said they will be seeking people with this skill in the next 12 months” [2].

## A. ITBA and BA Curriculum (examples)

In order to follow industry trends and needs, several U.S. and international universities started an introduction of courses and certificate programs focused on BA and ITBA areas in their curricula (Table I).

TABLE I. EXAMPLES OF IDENTIFIED ITBA AND BA CURRICULUM IN U.S. OR INTERNATIONAL UNIVERSITIES

#	School Name	Course Offered	Ref.
<b>Programs in ITBA (all identified examples)</b>			
1	Purdue University – Purdue Polytechnic Institute, USA	Master of Information Technology Business Analysis Online	[3]
2	Swinburne University of Technology, Australia	Master of Information Technology Business Analysis	[4]
3	Cambrian College, Canada	Information Technology Business Analysis	[5]
<b>Programs in BA (several examples)</b>			
4	University of California - Berkeley Extension	Certificate Program in Business Analysis	[6]
5	George Mason University	Business Analysis Certificate program	[7]
6	Duke University	Business Analysis Certificate programs	[8]
7	Georgia State University	Business Analysis concentration	[9]
8	St. Louis University	Executive Certificate program in Business Analysis	[10]
9	University of Wisconsin-Milwaukee	Business Analyst Certificate program	[11]
10	University of Washington, Prof. and Continuing Education	Certificate in Business Analysis	[12]
11	Portland State University, Center for Executive and Professional Education	Business Analysis Certificate program	[13]
12	Mount Royal University, Canada	Business Analysis Extension Certificate program	[14]
13	Loughborough University, UK	Business Analysis and Management MS Program	[15]

The analysis of obtained data (Table I) clearly shows that the vast majority of universities offer programs in traditional BA area, and only a few of them – in the emerging ITBA area.

### *B. BA and ITBA Scope*

BA scope includes but is not limited to “... the definition of organizational goals, how those goals connect to specific objectives, determining the courses of action that an organization has to undertake to achieve those goals and objectives, and defining how the various organizational units and stakeholders within and outside of that organization interact. A business analyst is any person who performs business analysis activities, no matter what their job title or organizational role may be. Business analysis practitioners include not only people with the job title of business analyst, but may also include business systems analysts, systems analysts, requirements engineers, process analysts, product managers, product owners, enterprise analysts, business architects, management consultants, or any other person who performs the tasks described in the BABOK® Guide, including those who also perform related disciplines such as project management, software development, quality assurance, and interaction design” [16].

ITBA scope is focused on improvement of organization’s main business operations and functions that are based or involve active utilization of numerous IT components and services. ITBA involves a) analysis of current (existing) and b) design, implementation, integration and testing of new more effective hardware and software systems, IT and communication services in organization.

In general, ITBA analyst should be able to 1) evaluate organization’s main business processes and functions, 2) identify and analyze business or customer requirements, and translate them into new IT project specifications, 3) propose various IT solutions (alternatives) that support (meet the requirements from) multiple stakeholder groups, 4) look well beyond one current project, one technical platform, one software or computer information system in organization, 5) create plans for proposed IT solutions, and identify, communicate, and manage risks associated with IT solutions.

As a result, ITBA graduate must obtain a wide portfolio of needed important analytical, technical, management and communication skills.

### *C. The Outcomes of Analysis*

The analysis of the current status of ITBA profession in industry clearly shows that in upcoming years it will need a significant number of well educated and highly skilled ITBA professionals with specializations both BA area and computing and engineering areas. However, we identified only 3 international universities – one in the U.S.A., one – in Canada, and one in Australia - that offer pioneer ITBA programs.

These findings and outcomes motivated us – faculty and graduate students at the Department of Computer science and Information Systems, Bradley University (Peoria, IL, U.S.A.) – to design, and develop innovative ITBA academic curriculum and courseware as described below.

The CS&IS Department has a solid foundation to succeed in this project – for many years we offer the following academic courses for seniors and graduate students: 1) CIS 475/575 cross-listed undergraduate/graduate “Computer Information Systems Analysis, Design and Integration” courses, 2) CIS 491/591 cross-listed “Software/Computer Information Systems Project Management” (including Risk Management) courses, 3) CIS 572 “Computing Management: Systems, Technology, Services” graduate course, 4) CIS 573 “Quality Management in Computing” graduate course, and 5) CIS 697 “Advanced Topics in CIS” courses with a focus on various topics such as Agile Methodology, Six Sigma Methodology, and Project Management Professional – PMP.

## II. ITBA CURRICULUM DESIGN PHASE: GOAL AND OBJECTIVES

The overall goal of the proposed project is to make a valuable and timely contribution to the curricula and overall mission of the CS&IS Department by analysis, design, development and implementation of innovative ITBA curriculum.

In order to achieve project goal, the project team identified the following objectives:

- main topics: identify a list of main ITBA concepts, systems, technologies that are in high demand by various enterprises in industry – those topics must be included into ITBA main topics;
- courseware: design and develop innovative academic ITBA curriculum, including a) main topics and quality learning content, b) assignments for lab sessions and course research, design and development projects, c) midterm and final exams; d) offer various modes on learning content delivery: in-class, online, and blended;
- tools and practices to be used: identify most effective ITBA tools and practices – those that are actively used in IT industry, and implement them into proposed ITBA curriculum;
- collaboration and research: perform active research in ITBA area and collaborate with local industry to develop real world assignments for course learning assignments and/or capstone projects, and, thus, enhance our graduates’ knowledge base, hands-on skills, market value and competitiveness.

## III. ITBA CURRICULUM DESIGN PHASE: MAIN TOPICS

Based of our analysis of ITBA applications in industry and obtained research findings, we identified a list of main topics in the proposed ITBA curriculum -- they are presented in Table II. Main topics are supported by active use of

- multiple real-world examples from computing and engineering – examples that support each main topic in the curriculum;
- Web-based resources from IT, CS, CIS and ITBA researchers and practitioners;

- interviews with experts from industry;
- the outcomes of SWOT (Strength-Weaknesses-Opportunities-Threats) analysis, and tangible and intangible benefits of ITBA applications in industry.

TABLE II. MAIN TOPICS OF PROPOSED ITBA CURRICULUM

Main Topic	Sub-topics
Introduction to ITBA	<ul style="list-style-type: none"> <li>• What is ITBA</li> <li>• Scope of ITBA</li> <li>• Key areas of ITBA</li> <li>• Modern Trends in ITBA</li> <li>• ITBA: Market Status</li> <li>• ITBA vs BA: a creative comparison</li> </ul>
ITBA main knowledge areas (KAs)	<ul style="list-style-type: none"> <li>• Introduction to KAs</li> <li>• IT Project Management (an overview)</li> <li>• BABOK Guide (an overview)</li> </ul>
ITBA: planning and monitoring	<ul style="list-style-type: none"> <li>• Planning of BA Approach</li> <li>• Conduct Stakeholder Analysis</li> <li>• Planning of BA Activities</li> <li>• Planning of BA Communication</li> <li>• Planning of Requirements Engineering</li> <li>• Management of BA Performance</li> </ul>
Requirements elicitation	<ul style="list-style-type: none"> <li>• Requirements Gathering vs. Requirements Elicitation</li> <li>• Requirements Elicitation Techniques               <ol style="list-style-type: none"> <li>1) Brainstorming</li> <li>2) Document Analysis</li> <li>3) Focus Groups</li> <li>4) Interface Analysis</li> <li>5) Interviews</li> <li>6) Observation</li> <li>7) Process Modeling</li> <li>8) Prototyping</li> <li>9) Requirements Workshops</li> <li>10) Survey/Questionnaire</li> </ol> </li> </ul>
Enterprise analysis	<ul style="list-style-type: none"> <li>• Enterprise Analysis Activities</li> <li>• Creating and Maintaining a Business Architecture</li> <li>• Analysis of Business Needs and Techniques</li> <li>• Assessing Capability Gaps; Techniques to handle it</li> <li>• Solution Approach and Technique to handle it</li> <li>• Scope</li> <li>• Business Case</li> </ul>
Requirements analysis	<ul style="list-style-type: none"> <li>• Prioritize Requirements               <ol style="list-style-type: none"> <li>1) Decision Analysis</li> <li>2) Risk Analysis</li> <li>3) MoSCoW Analysis</li> </ol> </li> <li>• Organize Requirements               <ol style="list-style-type: none"> <li>1) Data Flow Diagrams</li> <li>2) Data Modeling</li> <li>3) Process Modeling</li> <li>4) Scenarios and Use Cases</li> <li>5) Scope Modeling</li> </ol> </li> <li>• Specify and Model Requirements               <ol style="list-style-type: none"> <li>1) Key Performance Indicators and Key Risk Indicators</li> <li>2) Sequence Diagram</li> <li>3) State Diagram</li> </ol> </li> </ul>
Research project 1	<ul style="list-style-type: none"> <li>• Mastering Requirements Engineering analytical skills</li> </ul>
Solution assessment and validation	<ul style="list-style-type: none"> <li>• Define Assumptions and Constraints: 1)Risk Analysis, 2) Acceptance and Evaluation Criteria, 3) Checklists</li> <li>• Validate Requirements : 1) KPI and KRI, 2) Prototyping, 3) Risk Analysis</li> </ul>

Solution assessment and validation	<ul style="list-style-type: none"> <li>• Quality Assurance Plan</li> <li>• Propose and Validate Solution               <ol style="list-style-type: none"> <li>1) Root Cause Analysis</li> <li>2) User acceptance testing</li> <li>3) Defect and Issue Reporting</li> </ol> </li> <li>• RFI, RFQ and RFP</li> </ul>
Research project 2	<ul style="list-style-type: none"> <li>• Mastering Assessment and Validation analytical skills</li> </ul>
Database analysis and design (an overview)	<ul style="list-style-type: none"> <li>• Fundamentals of relational data model</li> <li>• Logical Data model</li> <li>• Entity Relationship diagrams</li> <li>• Normalization techniques</li> <li>• Basic Queries : DDL, DML, DCL</li> </ul>
IT and CIS project management (an overview)	<ul style="list-style-type: none"> <li>• IT/CIS development project estimate: LOC-based estimate</li> <li>• IT/CIS development project estimate: FP-based estimate</li> <li>• IT/CIS development project estimate: historic data-based estimate</li> <li>• IT/CIS development project estimate: COCOMO model-based estimate</li> <li>• IT/CIS development project estimate: automatic tools based estimate</li> </ul>
Underlying competencies (an overview)	<ul style="list-style-type: none"> <li>• Analytical Skills</li> <li>• Systems' Thinking</li> <li>• Business Knowledge</li> <li>• Technical Skills</li> <li>• Software and Computer Information Systems</li> <li>• IT Infrastructure</li> <li>• Communication Skills</li> <li>• Management Skills</li> <li>• Leadership Skills</li> </ul>
Lab session 1	<ul style="list-style-type: none"> <li>• Mastering ITBA technical skills with <i>Tableau</i> tool</li> </ul>
Lab session 2	<ul style="list-style-type: none"> <li>• Mastering ITBA technical skills with <i>Qlikview</i> tool</li> </ul>
Lab session 3	<ul style="list-style-type: none"> <li>• Mastering ITBA technical skills with <i>JIRA</i> tool</li> </ul>
Capstone project	<ul style="list-style-type: none"> <li>• Comprehensive course project on ITBA main topics, practices and tools</li> </ul>

#### IV. ITBA CURRICULUM DESIGN PHASE: ADVANCED ITBA LAB PRACTICUM

The crucial components of the developed ITBA curriculum are advanced laboratory sessions aimed at obtaining highly demanded technical skills and hands-on experience with various related advanced tools; several tools and developed labs are described below.

##### A. Lab # 1: Mastering Technical Skills with Tableau Tool

The goal of this lab is to provide students with hands-on experience and develop technical skills for topics relevant to monitoring and management of critical business processes and people in project teams.

Lab learning objective # 1: Create a performance dashboard using the *Tableau* tool [17].

Performance dashboard is used by ITBA experts and project managers to perform various functions such as:

- 1) monitor critical business processes using metrics of business performance – those that automatically trigger alerts when potential problems arise;
- 2) analyze the roots that cause problems by exploring relevant and timely data/information from multiple perspectives and at various levels of details;

- 3) manage people and processes to improve decisions, optimize performance, and guide an organization or project team in the right direction.



Fig. 1. Lab 1 – learning objective # 1 (an example of possible outcome)

Lab learning objective # 2: a) Get basic knowledge and functionality of the *Tableau* tool; for example, extract data from excels and perform joins after finding relationship between data, and b) Develop understanding of dimension and measure.

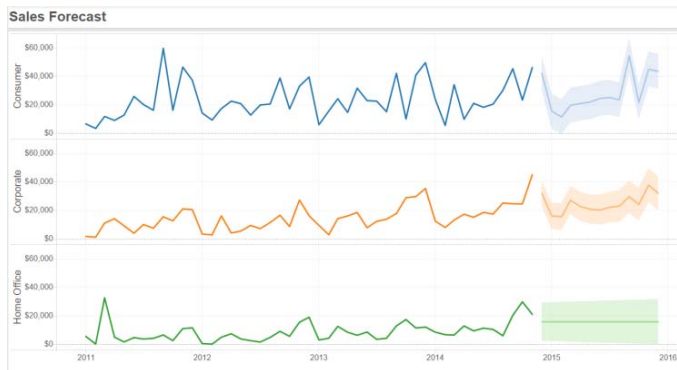


Fig. 2. Lab 1 – learning objective # 2 (an example of possible outcome)

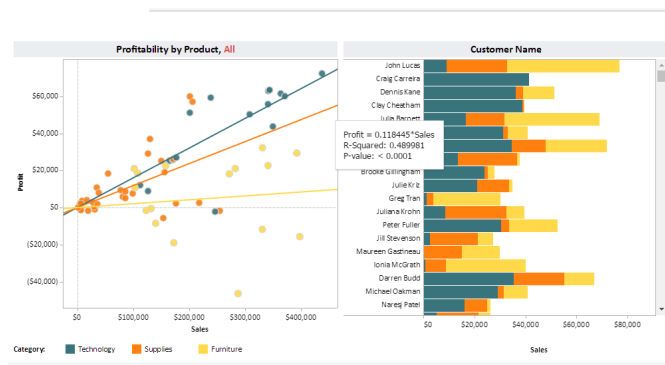


Fig. 3. Lab 1 – learning objective # 3 (an example of possible outcome)

Lab learning objective # 3: Create map chart for global sales and profit. Create trend chart for comparing the monthly

profit by different segments and categories. Create a dashboard for the brief overview.

Lab learning objective # 4: Create a crosstab for determining the profits in various categories. Identify a category that has less profit and needs to be analyzed further. Identify year-to-year trend. Perform the basic forecasting. Learn filters in the dashboard.

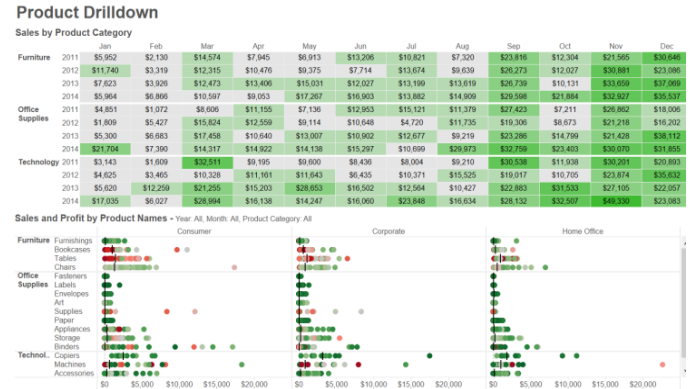


Fig. 4. Lab 1 – learning objective # 4 (an example of possible outcome)

B. Lab # 2: Mastering Technical Skills with Qlikview Tool

The goal of this lab is to provide students with hands-on experience and develop technical skills for topics relevant to creating maps, charts, etc. in ITBA using *Qlikview* tool [18].

Lab learning objective # 1: Create maps and analyze areas with various (max, min) profits. Determine profit margins.

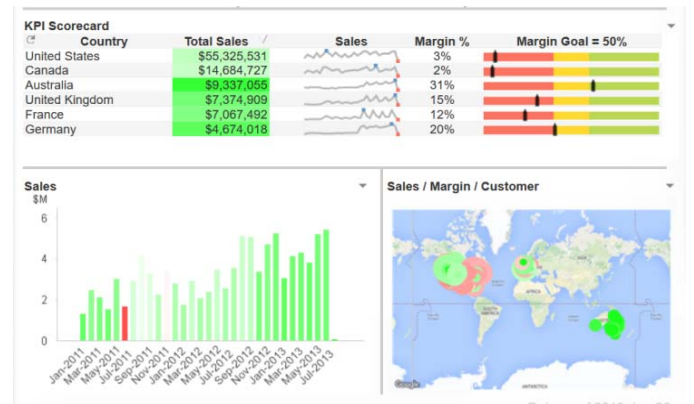


Fig. 5. Lab 2 – learning objective # 1 (an example of possible outcome)

Lab learning objective # 2: Divide time scale by *Year*, *Months* and *Quarters*. Provide filters. Compare sales for 2 given years/months/quarters.

Lab learning objective # 3: Create graph for sales vs. profit margin. Create graphs for total sales with respect to country, and total sales with respect to year.

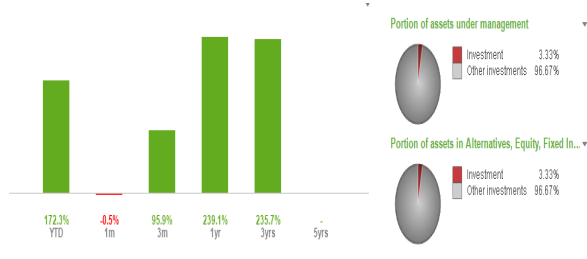


Fig. 6. Lab 2 – learning objective # 2 (an example of possible outcome)

### C. Lab # 3: Mastering Technical Skills with JIRA Tool

JIRA tool [19] is a management platform that allows ITBA experts and project managers to manage project-related issues throughout their entire project lifecycle.

Lab # 3 learning objectives are:

- 1) create business use case (a possible outcome is presented on Fig. 7);

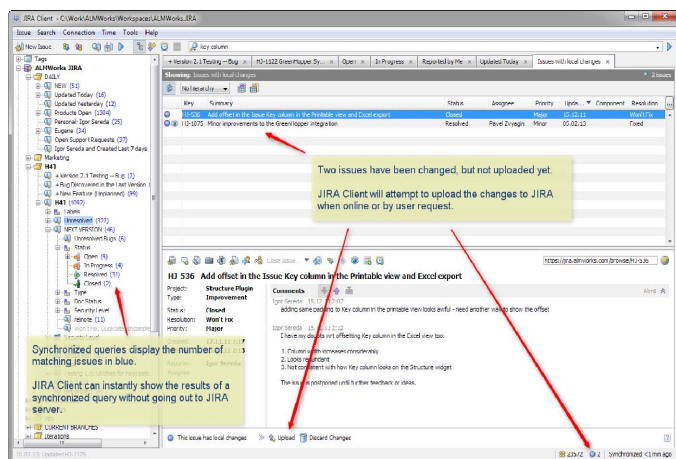


Fig. 7. Lab 3 – learning objective # 1 (an example of possible outcome)

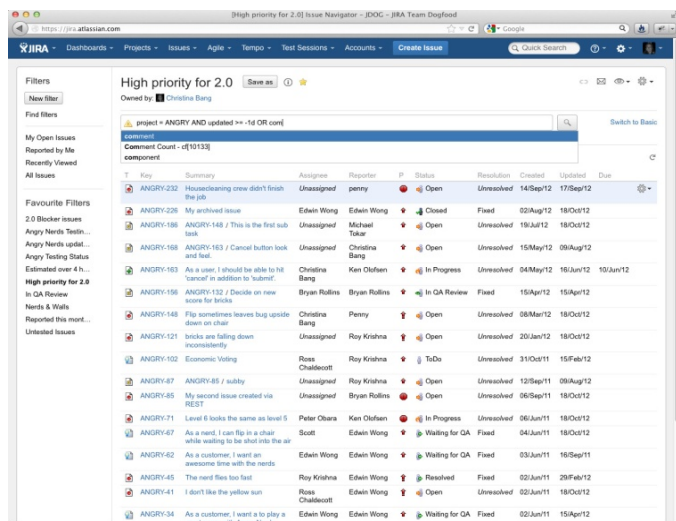


Fig. 8. Lab 3 – learning objective # 3 (an example of possible outcome)

- 2) create a test case;
- 3) assign identified bugs and create defect reports (a possible outcome is presented on Fig. 8);
- 4) perform unit testing and peer-to-peer testing;
- 5) create context diagram (a possible outcome is presented on Fig. 9);
- 6) create use case diagram (a possible outcome is presented on Fig. 10);
- 7) create business objective model.

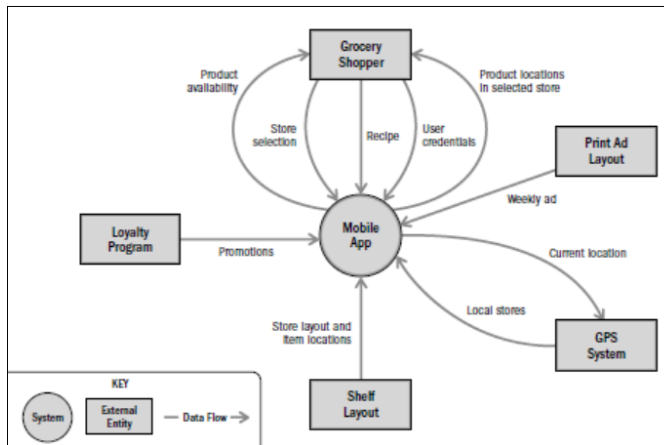


Fig. 9. Lab 3 – learning objective # 5 (an example of possible outcome)

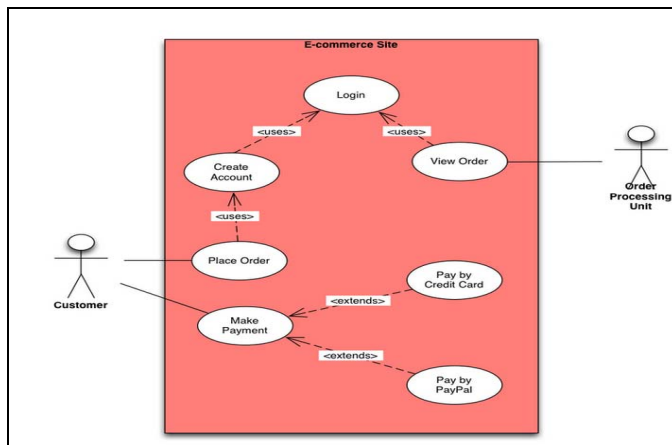


Fig. 10. Lab 3 – learning objective # 6 (an example of possible outcome)

## V. ITBA CURRICULUM: PROJECT FINDINGS

In 2015-2016 one of the co-authors taught pilot learning modules of ITBA courses as a part of CIS 697 “Computer Information Systems: Advanced Topics” and CIS 698 “Directed Individual Studies in CIS” graduate courses. Most of developed ITBA main topics were presented and tested in both face-to-face and online learning modes to students during Fall-2016 and Spring-2016 semesters.

Various tools for ITBA lab sessions were installed and carefully tested by co-authors; based on outcomes of testing we

arrived with a conclusion to use three above-mentioned tools in ITBA lab practicum, specifically: *Tableau*, *Qlikview*, and *JIRA* tools.

Additionally, in 2015-2016 several graduate students performed joint student-faculty research in ITBA area under a supervision of one of the co-authors.

The described project on analysis, design and development of innovative ITBA curriculum was based on active student-faculty collaboration. All three student co-authors have experience of working in industry in various large-size and mid-size companies with a focus on traditional system analysis and design processes. Generated-by-students ideas about ITBA curriculum structure, learning content, assignments for lab sessions and course projects were very instrumental and significantly improved the quality of proposed, developed and implemented ITBA curriculum.

Based on the outcomes of a) pilot ITBA modules' teaching, and b) obtained student and research associates' feedback, the up-to-date project findings are as follows:

- **Team working skills.** Several learning modules and lab sessions on a) team working skills and b) various roles playing in a team should be completed by students to obtain quality ITBA team working skills. This is important because a student should be play effectively various roles in ITBA team, for example, a) system analyst, b) ITBA analyst, 3) hardware expert, 4) software expert, 5) security expert, 6) IT project manager or assistant to project manager, etc.
- **ITBA analytical skills and best practices.** Students in ITBA teams must use and master in as many ITBA practices as possible to become well-prepared for real-world business cases. Those practices include but are not limited to: 1) elicitation of business or customer requirements, 2) development of functional requirements for businesses or customers, 3) structured analysis, 4) systems-based thinking and object-oriented analysis, 5) end-user support, 6) post implementation reviews, 7) agility, etc.
- **ITBA technical skills.** Student ITBA teams should learn and use various available ITBA tools to obtain quality technical skills in ITBA area. Multiple ITBA related tools are available these days – open source free and commercial ones. It is strongly recommended for students to gain technical skills and become proficient with 5-7 major ITBA tools.
- **ITBA communication skills.** The vast majority of courses in university environment are offered in face-to-face modes. However, it is essential for ITBA student teams to learn basics of a) virtual team working, and b) modern Web-based collaboration and communication tools, and, therefore, master ITBA communication skills. As a result, it is strongly recommended to simulate Web-based working environment in ITBA curriculum; for example, by mandatory active use of Web-based communication and collaboration tools.

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