Summary of Professional Achievements

1. Name and Surname: Ryszard Błażej, born on Nov. 26, 1969 in Głogów
2. Diplomas awarded, academic degrees – please provide the name, place, date and the title of the doctoral dissertation

1994	M.Sc., B.Eng. of Mining, Wroclaw University of Science and Technology, Faculty of Mining, specialization: underground mining
2001	Doctor of technical sciences - in mining and engineering geology at Wroclaw University of Science and Technology, awarded on the basis of a doctoral dissertation titled *Wpływ Właściwości Mechanicznych Rdzenia Taśm Przenośnikowych Tkaninowo-Gumowych na Wytrzymałość Ich Połączeń* [*The Influence of the Mechanical Properties of the Core of Textile Conveyor Belt on Splice Strength*].

3. Information on work experience in research institutions:

Mar. 01 - Sept. 30, 1994	Technician – already as a student, I was employed at Zakład Systemów Maszynowych (Machine Systems Division, further: MSD), Wroclaw University of Science and Technology (WUST)
1994-2001	Teaching and research assistant – WUST, Faculty of Mining, employed at Laboratorium Transportu Taśmowego (Belt Conveying Laboratory, further: BCL) and at MSD
1997-2001	Doctoral program – Wroclaw University of Science and Technology, Faculty of Mining
2001 – present	Assistant Professor – Faculty of Geoengineering, Mining and Geology, WUST, Machine Systems Division
Aug. 01 2015 – present	Technical Head of the accredited Belt Conveying Laboratory

4. Indicate achievements* in accordance with Art. 16(2) of the Act on Academic Degrees and the Academic Title, and Degrees and Title in the Field of Art of Mar. 14, 2003 (Journal of Laws 2016, item 882 with further amendments in Journal of Laws 2016, item 1311):

a) scientific achievement

Non-invasive diagnostics of conveyor belts

b) (author/authors, publication title/titles, publication date, publisher), reviewers

The scientific achievement comprises:

- single-authored monograph titled: ***Evaluation of the Condition of Conveyor Belts With Steel Cords***,
- a cycle of 8 co-authored publications and
- a set of 6 co-authored patents.

I. Single-authored monograph titled

EVALUATION OF THE CONDITION OF CONVEYOR BELTS WITH STEEL CORDS

Bibliographic data: ISBN 978-83-951536-0-0 Faculty of Geoengineering, Mining and Geology, WUST, Wrocław 2018, 160 pages.

Reviewers:

- Prof. Dr. Hab. Eng. Lech Gładysiewicz, Wroclaw University of Science and Technology
- Dr. Hab. Eng. Piotr Cheluszka, Associate Professor at Silesian University of Technology

II. Publication cycle:

1. **Ryszard Błażej**, Leszek Jurdziak, Tomasz Kozłowski, Agata Kirjanów: *The Use of Magnetic Sensors in Monitoring the Condition of the Core in Steel Cord Conveyor Belts – Tests of the Measuring Probe and the Design of the DiagBelt System.* Measurement (London). 2018, vol. 123, pp. 48-53, 10 figs., bibliogr. 22 pos. ISSN: 0263-2241. **Ministry of Science and Higher Education (further: MSHE) points of: 2013-2016: 30. ISI Master Journal List Impact Factor: 2.218** (2017).
2. **Ryszard Błażej**, Leszek Jurdziak, Agata Kirjanów, Tomasz Kozłowski: *Core Damages Increase Assessment in the Conveyor Belt With Steel Cord.* Diagnostyka (Warszawa). 2017, vol. 18, No 3, pp. 93-98, 8 figs., 2 tab., bibliogr. 16 pos., Abbr. ISSN: 1641-6414, **MSHE points of: 2013-2016: 11;**
3. **Ryszard Błażej**, Leszek Jurdziak, Agata Kirjanów, Tomasz Kozłowski: *A device for measuring conveyor belt thickness and for evaluating the changes in belt transverse and longitudinal profile*. Diagnostyka (Warszawa). 2017, vol. 18, No 4, pp. 97-102, [4] phot., 9 figs., bibliogr. 12 pos., Abbr. ISSN: 1641-6414, **MSHE points of: 2013-2016: 11**;

4. **Ryszard Błażej**, Leszek Jurdziak, Witold Kawalec: *Condition Monitoring of Conveyor Belts as a Tool for Proper Selection of Their Replacement Time.* In: Advances in Condition Monitoring of Machinery in Non-Stationary Operations: Proceedings of the Fourth International Conference on Condition Monitoring of Machinery in Non-Stationary Operations, CMMNO'2014, Lyon, France, December 15-17 / Fakher Chaari [et al.] eds. Cham [et al.] : Springer, cop. 2016. pp. 483-494, 6 figs., bibliogr. 33 pos. [vol. 0,8]. ISBN: 978-3-319-20462-8. (Applied Condition Monitoring, ISSN 2363-698X; No 4). **Web of Science: 15.**
5. **Ryszard Błażej**, Leszek Jurdziak, Witold Kawalec: *Operational Safety of Steel-Cord Conveyor Belts Under Non-Stationary Loadings.* In: Advances in Condition Monitoring of Machinery in Non-Stationary Operations: Proceedings of the Fourth International Conference on Condition Monitoring of Machinery in Non-Stationary Operations, CMMNO'2014, Lyon, France, December 15-17 / Fakher Chaari [et al.] eds. Cham [et al.] : Springer, cop. 2016. pp. 473-481, 5 figs., bibliogr. 16 pos. [vol. 0,6]. ISBN: 978-3-319-20462-8. (Applied Condition Monitoring, ISSN 2363-698X; No 4). **Web of Science: 15.**
6. **Ryszard Błażej**: *Inteligentny System Diagnostyki Taśm Przenośnikowych – Budowa i Działanie*. Transport Przemysłowy i Maszyny Robocze. 2015, vol. 2, pp. 15-21, 14 figs., bibliogr. 18 pos., Summ. ISSN: 1899-5489. **MSHE points of 2013-2016: 04**.
7. **Ryszard Błażej**, Leszek Jurdziak, Radosław Zimroz: *Novel Approaches for Processing of Multi-Channels NDT Signals for Damage Detection in Conveyor Belts With Steel Cords*. Engineering Materials. 2013, vol. 569/570, pp. 978-985, 8 figs., bibliogr. 13 pos. ISSN: 1013-9826, Vol. Title: Damage Assessment of Structures X. Pt. 2 / ed. by Biswajit Basu. 10th International Conference on Damage Assessment of Structures (DAMAS 2013), July 8-10, 2013, Dublin, Ireland. **Web of Science: 15.**
8. **Ryszard Błażej**, Leszek Jurdziak, Agata Kirjanów, Tomasz Kozłowski: *Evaluation of the Quality of Steel Cord Belt Splices Based on Belt Condition Examination Using Magnetic Techniques*. Diagnostyka (Warszawa). 2015, vol. 16, No 3, pp. 59-64, 10 figs., bibliogr. 10 pos., Abbr. ISSN: 1641-6414, **MSHE points of: 2013-2016: 11**;

III. Patents:

1. Patent. Poland, No 216253. ***Urządzenie do miejscowego badania taśm przenośnikowych [Device for local tests of conveyor belts*]**. Authors: Ryszard Błażej, Leszek Jurdziak, Monika Hardygóra, Radosław Zimroz.
2. Patent. Poland, No 227740. ***Sposób wykrywania uszkodzeń taśmy przenośników taśmowych* [*Method for belt damage detection in belt conveyors].*** Authors: Ryszard Błażej, Monika Hardygóra, Leszek Jurdziak, Radosław Zimroz, Maciej Szupieńko.
3. Patent. Poland, No 220897. ***Sposób wykrywania rozcięć wzdłużnych taśm przenośnikowych i urządzenie do pomiaru szerokości taśm przenośnikowych* [*Method for detecting longitudinal cuts of conveyor belts and a device for measuring the width of conveyor belts]***. Authors: Ryszard Błażej, Leszek Jurdziak
4. Patent. Poland, No 220889. ***Sposób wykrywania rozcięć wzdłużnych taśm przenośnikowych i urządzenie do pomiaru szerokości taśm przenośnikowych* [*Method for detecting longitudinal cuts of conveyor belts and a device for measuring the width of conveyor belts]***. Authors: Ryszard Błażej, Leszek Jurdziak.
5. Patent. Poland, No 227912. ***Metoda do ciągłego monitorowania długości i wydłużeń taśmy przenośnikowej będącej w ruchu* [*Method for the continuous monitoring of***

the length and elongation of a moving conveyor belt]. Authors: Ryszard Błażej, Leszek Jurdziak, Tomasz Kozłowski, Agata Kirjanów.

6. Patent. Poland, No 228973. ***Urządzenie do pomiaru grubości oraz oceny zmian profilu poprzecznego i wzdłużnego taśmy przenośnikowej [A device for measuring conveyor belt thickness and for evaluating the changes in belt transverse and longitudinal profile].*** Authors: Ryszard Błażej, Leszek Jurdziak, Lech Gładysiewicz, Tomasz Kozłowski, Agata Kirjanów.

c) description of the scientific objective of the above works and of the results achieved along with their potential application.

Conveyor belts represent a significant investment and operational cost related to continuous transportation in mines, ports, smelting plants, power plants, chemical plants and in other sectors in which continuous long-distance transportation of bulk materials remains of key importance. The exact length of conveyor belts installed in Poland is not known, but estimated already at thousands kilometers. With the price of conveyor belts reaching 1 000 pln per 1 running meter (the cost of steel-cord belts used in lignite mines), their purchase and replacement account for up to 60% of the transportation costs in mines. The KWB Bełchatów mine alone, which is part of the PGE GiEK SA company, operates more than 300 km of conveyor belts and their annual belt replacement budget is of several tens of millions pln.

Thus, conveyor belts are a very precious element of belt conveyors operated in the mining industry. But their importance in not only due to their price. By providing continuous transportation of large amounts of bulk materials, belt conveyors also help reduce unit transportation cost. They prove competitive to road transport in all situations in which transportation routes do not change frequently, and to rail transport – at distances of one hundred or more kilometers. The longest belt conveyors in the world have lengths exceeding 20 km (e.g. in the Curragh coal mine, Australia) and the longest belt conveyor runs may have lengths of 100 km (e.g. the Bou Craa bou craa phosphate mine in Western Sahara).

Belt transportation offers indisputable advantages provided that belt conveyors operate reliably. Their runs form a system which is arranged in a series and for this reason the malfunction of just one component of a belt conveyor may cause downtime-related production losses or delayed deliveries. Current technology allows all components of belt conveyors, including conveyor belts, to be monitored. Unfortunately, belt monitoring in Poland is used on a limited scale and Polish technical solutions are based on magnetic heads which are designed to monitor flat rubber and steel balance ropes. As the lengths of transportation routes and of individual belt conveyors increase, so does the importance of non-invasive diagnostic systems which allow the technical condition of belts to be regularly monitored. In 2009, on behalf of a lignite mine, we conducted an analysis of the commercially available monitoring systems. Since all of the significant manufacturers of such devices operated in other continents and preferred to offer belt-scanning services rather than to sell their products, let alone to allow modifications and adjustments to their devices, we identified the need to develop original solutions which would be adapted to the needs of local customers. Thus, a group was formed in the Machinery Systems Division and under my leadership to devise new solutions. I took efforts to obtain financial support from the MSHE, and as a leader I applied for grants. I was granted funds to carry out two projects: the first one (2009-2012) – the MSHE research project titled *Kompleksowa Metoda Oceny Zużycia*

Taśm Przenośnikowych i Jej Wykorzystanie do Opracowania Racjonalnej Strategii Wymian [*Complex Method of Conveyor Belt Wear Degree Estimation and Its Application in Developing a Rational Belt Replacement Strategy]* (MSHE research project No. N N504 348036) and the second one (2012-2015) – the National Centre for Research and Development (NCRD) project titled *Inteligentny System do Automatycznego Badania i Ciągłej Diagnozy Stanu Taśm Przenośnikowych* [*Intelligent System for Automatic Inspection and Continuous Diagnostics of Conveyor Belt Condition]* (Agreement No PBS1/A2/5/2012). In the meantime, on behalf of the KWB Turów mine we carried out a project to modernize the EyeQ diagnostic system, which the mine bought in 2000. The system was originally developed for Dunlop: it aggregated data for four measuring circuits and delivered results which were difficult to interpret. After modernization, its resolution was increased 6-fold, and each of the 24 measuring circuits was 10 cm wide, providing much more accurate images of defective areas and identifying the exact damage location on belts up to 2400 mm wide. The new software developed for the device allowed not only allowed a two-dimensional visualization of belt core condition, but also enabled the user to enter aggregated belt damage measurements, such as damage density, both for complete belt sections (in order to inform decisions about replacing them) and in the form of a damage histogram along belt axis (in order to identify local damage concentrations which urgently require repairs). The color-coded 4-level gradation of belt condition allows a quick visual evaluation of all belt segments in a loop. The new solution was tested in actual mining conditions and included in a new version of the system, called DiagBelt, which was developed as part of the NCRD grant. Based on previous research and experience, we designed a device equipped with a set of “ideal” features expected by users.

- We developed a method for the visual inspection of the condition of the belt covers and edges [patent No. 1 and 2] (the **vision module**).
- We used the digital image from a very high-resolution magnetic head (magnetic probe bar of the BeltGuard system manufactured by an Australian company Beltscan with 1 measurement circuit having 25 mm) to evaluate and visualize the technical condition of the belt core. By using special algorithms to analyze signals, we were able to identify and separate all splices and to identify defects in all belt loop segments, as well as to evaluate their condition in accordance with the proposed, aggregated measures [7].
- We prepared preliminary procedures for predicting the development of damage density in time (the **prediction module**). Agata Kirjanów, M.Sc., Eng. used statistical analyses of the results of a series of measurements performed in an underground mine to select the regression curves. The research was performed as part of her Ph.D. dissertation titled: *Model Rozwoju Uszkodzeń Rdzenia Taśm Przenośnikowych z Linkami Stalowymi* [*A Model of Damage Development in the Core of Steel Cord Conveyor Belts*] prepared under the supervision of Dr. Hab. Eng. Leszek Jurdziak, Associate Professor at WUST.
- The relationship between the threat of belt loop discontinuation (both in the splice and in other belt parts) and the values of stresses which occur in in the loop traveling around the conveyor motivated us to develop a **safety module** which allows the user to determine safety indexes based on stress calculations (performed in the QNK TT software application) and on the current belt condition [5].
- Conveyor belts may lose their transportation capabilities not only due to cumulative degradation processes affecting their condition (increasing damage density, cover

abrasion, fatigue processes etc.), but also because of sudden events resulting in belt cuts over great distances. Such events cannot be predicted and therefore it is necessary to install special devices which are able to detect cuts and stop the conveyors [patent 3 and 4]. These devices may interact with the DiagBelt system in the **prevention module**.

All of the developed monitoring methods and modules have been integrated in one diagnostic system named ***DiagBelt*** [6]. The monitoring and research methods, as well as the prototype, were verified and tested on a belt conveyor in order to calibrate the system [1, monograph]. The system's modular structure allows its further extension. As a result, after the NCRD-funded project had been completed, the system was expanded with another module, which uses the difference method to measure belt thickness in particular locations across the belt section and along its circumference, while the belt is scanned. Thus, the user may obtain the belt's longitudinal or transverse profiles in an indicated location and along the complete loop [3, patent 6]. Research is also performed into the evaluation of the condition and quality of splices in steel-cord belts [8]. In the state of the art, these are first identified automatically and then subjected to visual inspection. The changes in the length of the belt may also be verified for the whole cross-section and during the operation of the conveyor [patent 5]. The doctoral dissertation prepared by Tomasz Kozłowski, M.Sc., B.Eng. under the supervision of Dr. Hab. Eng. Radosław Zimroz and titled *Ocena Stanu Technicznego Połączeń Taśm Przenośnikowych z Linkami Stalowymi na Podstawie Analizy Sygnałów Magnetycznych* [*Analysis of Magnetic Signals in the Evaluation of the Condition of Splices in Conveyor Belts With Steel Cords*] focuses on new algorithms for automatic evaluation of splice geometry and current technical condition. I am a supporting supervisor in the conferment procedure for this doctoral degree.

It is clear from the above that the advantage of the above-described solution over other commercially available solutions consists in the ability to improve and expand the device with the use of additional functions, sensors and measuring appliances. In the case when the system is implemented in a mine, it will be possible to further adjust it to the requirements and needs of a particular user by referring to identified processes characteristic of the type of the transported material and of the application of the belt conveyors. Different types of conveyors (e.g. overburden, coal, fixed, movable, short or long conveyors) entail different types of problems. Also, different issues must be investigated when scanning a belt in motion (identifying defects which may pose a threat to the continuous operation of the belt conveyor system) and when the belt is qualified for regeneration, prior to cover milling (identifying belt core condition in order to verify whether a belt segment qualifies for regeneration and indicating all areas which require repairs). In the currently used methods, core condition may be assessed only after the core is exposed, while the evaluation should be possible when the belt is still on the conveyor, so that the decision to disassemble the belt for regeneration can be made at an optimal time [4].

Information about achievements, research results, publications and awards were successively published on a purpose-made website (http://diagbelt.pwr.edu.pl/index.php/pl/).

The ***DiagBelt*** system employs a number of innovative ideas, measurement methods and signal-processing algorithms, which I developed while managing research works, modernizing the High Resolution Diagnostic System (HRDS) and constructing its prototype. My sound technical education in the broadly defined field of mechanics and practical sense

helped me move in a short time from the stage of identifying user needs and producing creative ideas to the stage of developing adequate measurement methods. These methods were used to construct, test, verify and calibrate the measuring and diagnostic devices. Until present, the DiagBelt system effected 6 patents, and several patent applications have been filed (e.g. an application on the use of the identified damage distribution across the belt section to modify the design and location of breakers for belt core protection), and many other innovative ideas are still in a phase in which they cannot be publicly announced.

The test methods and procedures of the ***DiagBelt*** system (the magnetic module) are successfully used in practical measurements [2]. The system served to perform 5 monitoring procedures of the condition of the ST 3150 steel-cord belt loop, 4.4 km in length, operated in an underground copper ore mine (the last measurement was taken on Oct. 14, 2018). The measurement reports allowed the belt user to perform the required repairs, and helped extend belt loop life to more than 7 years. This result represents a significant achievement, as the transported copper ore includes large, sharp-edged lumps. It would be impossible for the belt loop to be operated reliably for such a long period if all large-scale belt defects which pose a threat to the continuous operation of the belt conveyor have not been identified and reported in the course of the scanning procedures, allowing the user to make necessary repairs over a period of over two years.

The value of the system was noticed by the PGE GiEK SA O/KWB Bełchatów mine, which expressed interest in it and secured financial resources in the budget to implement it in 2018-2019. Bestgum, a company servicing conveyor belts, is another potential recipient of the system. It can also be used by other Polish belt manufacturers, which do not have such tools in their offer. All significant belt producing companies worldwide offer such systems, developed either as part of their own research and development works or ordered from external companies.

In order to promote the developed solutions, I organized a series of seminars, during which the potential of the ***DiagBelt*** system was presented to such companies as Bestgum, PGE GiEK SA O/ KWB Bełchatów, Sempertrans, Matador (Slovakia) and ZE PAK O/KWB Konin. The HRDS system is still used in the PGE GiEK SA O/KWB Turów mine. The system is continually improved and information about publications, patents, diploma theses and M.Sc. dissertations, as well as about prizes awarded, is posted on the dedicated website, which was developed as part of the NCRD grant.

5. Other scientific and research achievements

Apart from my recent, above-described research interests in non-invasive diagnostics of conveyor belts, I focus on a number of issues related to the topics I investigate both in the accredited Belt Conveying Laboratory (BCL), where I act as a technical supervisor, and in the Machinery Systems Division (MSD), which is my unit of affiliation.

The thematic scope of this research may be divided into the following areas:

A. Investigations into conveyor belt splices as part of projects carried out at BCL

B. Designing test stands and developing test methods on behalf of BCL and MSD

In the area of research into belts and belt splices (A), apart from dozens of belt and belt splice tests ordered by both belt users and manufacturers we conducted research aimed at:

- Increasing the strength, durability and reliability of belt splices;
- Developing new splicing technologies, as well as methods and tools for testing belts and their splices.

I carried out and managed two research projects:

1. The NCRD project: *Inteligentny System do Automatycznego Badania i Ciągłej Diagnozy Stanu Taśm Przenośnikowych* [*Intelligent System for Automatic Inspection and Continuous Diagnostics of Conveyor Belt Condition*]. Agreement No PBS1/A2/5/2012 as part of the applied research program, 2012-2015
2. The MSHE project N N504 348036: Kompleksowa Metoda Oceny Zużycia Taśm Przenośnikowych i Jej Wykorzystanie do Opracowania Racjonalnej Strategii Wymian [*Complex Method of Conveyor Belt Wear Degree Estimation and Its Application in Developing a Rational Belt Replacement Strategy*], 2009-2011.

I participated in six research projects, acting as a contractor or a main contractor:

3. Project No PBS3/A2/17/2015 titled *Złącza Wieloprzekładkowych Taśm Przenośnikowych o Zwiększonej Trwałości Eksploatacyjnej* [*Multiply Conveyor Belt Splices of Increased Service Life*]. 2015-2018.
4. Development project No N R09 0019 06/2009 titled *Przenośnik Taśmowy o Zwiększonej Efektywności Ekonomicznej i Energetycznej Zbudowany i Eksploatowany wg Zasad Zrównoważonego Rozwoju* [*A Belt Conveyor Having Increased Economic and Energy Effectiveness Constructed and Operated According to the Principles of Sustainable Development*], 2009-2012.
5. Ordinary KBN (State Committee for Scientific Research) project No 4T12A 06630 titled *Opracowanie Zasad Doboru Parametrów Wytrzymałościowych Taśm Przenośnikowych i Materiałów do Ich Łączenia Celem Uzyskania Optymalnej Wytrzymałości i Trwałości Połączeń* [*Criteria for Selecting Strength Parameters of Conveyor Belts and Splicing Materials for Optimal Splice Strength and Durability*], 2006-2008.
6. Targeted KBN project No 6T12 2002 C/05929. *Ekologiczna Technologia Łączenia Taśm Przenośnikowych* [*Ecological Conveyor Belt Splicing Technology*], 2003-2005.
7. Ordinary KBN project No 8T12A 03521 titled *Optymalizacja Konstrukcji Połączeń Taśm Przenośnikowych Wieloprzekładkowych o Zwiększonej Wytrzymałości*

Statycznej i Zmęczeniowej [*Optimal Design of Splices in Multiply Conveyor Belts Having Increased Static and Fatigue Strength*], 2001-2003.

8. Ordinary KBN project No 9T12 A 04015 titled *Połączenia Taśm Przenośnikowych Tkaninowo-Gumowych o Zwiększonej Wytrzymałości* [*Splices in Textile Conveyor Belts Having Increased Strength*], 1998-2000.

My achievements in this area: 3 articles in the proceedings of conferences held abroad, 10 articles in Polish journals, over 200 internal reports, analyses and expert opinions due to the tests carried out at BCL.

Research results constituting an original contribution to the discipline of mining and engineering geology in the field of mining transportation:

- developing an ecological technology and manual of splicing steel cord conveyor belts,
- implementing an ecological technology of belt splicing in the KWB Bełchatów and KWB Turów mines,
- developing a method for evaluating the strength of conveyor belt splices on the basis of optimized selection of the parameters of glues and compositions,
- developing an algorithm and the *ABS* software application on the basis of the developed method.

In the second research area (B) – designing test stands and developing test methods – I cooperated with other researchers to develop original test methods and test stands which served inter alia to carry out tasks being part of the first two research areas and the object of orders from external industrial clients.

The list below includes test stands designed solely by me or with my cooperation:

1. **Ryszard Błażej** – Designing and supervising the construction and the commissioning of a test stand for testing conveyor belt flammability with the use of flame method at the Belt Conveying Laboratory, 1997. My participation in the project covered literature review, the design of the apparatus and supervision of construction and commissioning. I estimate my participation as 100%.

2. **Ryszard Błażej,** Henryk Komander – Design of a rig for measuring the resistance to motion of idlers, 2002. My participation in the project covered literature review and the design of the apparatus. I estimate my participation as 50%.

3. **Ryszard Błażej,** Henryk Komander – Design of the ZP40 tensile testing machine for testing splices in conveyor belts at the Belt Conveying Laboratory, 1994. My participation in the project covered literature review and the design of the apparatus. I estimate my participation as 50%.

4. **Ryszard Błażej** – Design of a rig for testing surface and volume resistance of hard materials at the Belt Conveying Laboratory, 2007. My participation in the project covered literature review, the design of the apparatus and the supervision of the construction. I estimate my participation as 100%.

My scientific and research achievements include 7 patents (discussed in relation to the main scientific achievement), the construction of test stands at BCL, contribution in the development of 6 test methods as well as preparing the designs and supervising the construction of 3 test stands in the new GEO-3EM research center (https://www.wroclaw.pl/politechnika-rosnie-gmach-geo3em-przy-na-grobli).

Activity in the area of didactics and communication of science

As an employee of the Wroclaw University of Science and Technology I taught the following subjects:

1. Technical Drawing and Descriptive Geometry
2. Fundamentals of Machine Construction (I prepared an original lecture)
3. Mining Machinery Systems for the international study program Mining and Power Engineering (I prepared teaching materials for lectures and laboratory classes on belt conveying technology)

as well as classes and project classes:

a. Technical Drawing and Descriptive Geometry (AutoCAD)
b. Machinery Systems Laboratory
c. Machinery Systems Project

I supervised 14 M.Sc. and 16 B.Eng. dissertations and I reviewed over 30 M.Sc. and B.Eng. dissertations.

Organizational activity

I am a technical supervisor at the accredited Belt Conveying Laboratory.

Between 2012 and 2016 I was a member of the Faculty Board as a representative of Assistant Professors and I participated in the Faculty Election Commission.

Promoting the services of BCL and its research offer, I organized a number of seminars and trainings related to the diagnostics and splicing technologies in conveyor belts:

- in the following mines: KWB Bełchatów (2009 and 2018), KWB Turów (2011), KWB Konin (2014),
- and for the following conveyor belt manufacturers: Sempertrans (2016), Matador (Slovakia, 2016) Conbelts (2017), and
- for Bestgum – a company which services and regenerates conveyor belts (2017).

I was the secretary of the Basic Problems of Belt Transportation academic school in 1996 and I participated in organizing the Lower Silesian Festival of Science (1998-2001).

International cooperation

In 1995 I participated in a training organized by REMA TIP TOP Stahlgruber in Germany.

I also participated in a number of international scientific conferences:

1. Ryszard Błażej: A high resolution system for automatic diagnosing the condition of the core of conveyor belts with steel cords. In: XIII International Technical Systems Degradation Conference, Liptovský Mikuláš, 23-26 April 2014
2. Ryszard Błażej, Radosław Zimroz: A procedure of damage detection in conveyor belts using infrared thermography. In: XII International Technical Systems Degradation Conference, TSD, Liptovský Mikuláš, 3-6 April 2013
3. Ryszard Błażej, Leszek Jurdziak: Integrated diagnostic device for automatic assessment of conveyor belts condition In: 22nd World Mining Congress & Expo, 11-16 September, Istanbul-2011.
4. Ryszard Błażej: A comparison of experimental studies of the EyeQ and ABCD systems for damage detection in conveyor belts with steel cords. In: X International Technical Systems Degradation Conference, Liptovský Mikuláš, 27-30 April 2011.

As part of the Erasmus-Socrates international exchange program, I visited Dumplupinar University, where I spent one week presenting the results of my research and visited local mines.

I delivered seminars to Slovakian belt manufacturer Matador (2016). The company has not yet decided to buy our device, but they asked to prepare an offer. Matador is a subsidiary of ContiTech, which has its own solution after it purchased Veyance Technologies from Goodyear.

In 2014, we invited the head of the R&D department at Fenner-Dunlop to present our diagnostic solutions. Unfortunately, the meeting did not result in cooperation, as our solution was judged competitive to the solutions offered by Fenner-Dunlop. Earlier, cooperation also failed with Veyance (Goodyear), which refused to sell us the CoreGuard device, although for some time we exchanged our experiences with Dr. M. Alport, employed by Veyance to develop their own core scanner.

However, we cooperate with Beltscan from Australia, which sold us in 2011 the BeltGuard magnetic probe used in our prototype. The company operates mainly in Australia and South America, and our solution is complementary with their device, significantly extending its application potential.

I recently participated in the DISIRE project (Horizon 2020) titled *Integrated Process Control based on Distributed In-Situ Sensors into Raw Material and Energy Feedstock*. I organized tests of intelligent pellets to be used in an underground mine, but in the first stem we tested the functioning of Polish and Swedish antennas for collecting information encoded in the e-pelets dropped on the conveyor belt. For that purpose, we used the test belt conveyor at BCL – the same conveyor which originally served to test the DiagBelt system.

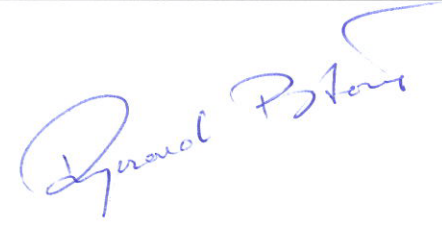
I am currently a contractor in the MaMMa project titled *Maintained Mine & Machine*, as part of framework agreement No FPA2016/EIT/EIT Raw Materials, Acronym: **MaMMa** 2018-2021.

Bibliometric summary of scientific achievements

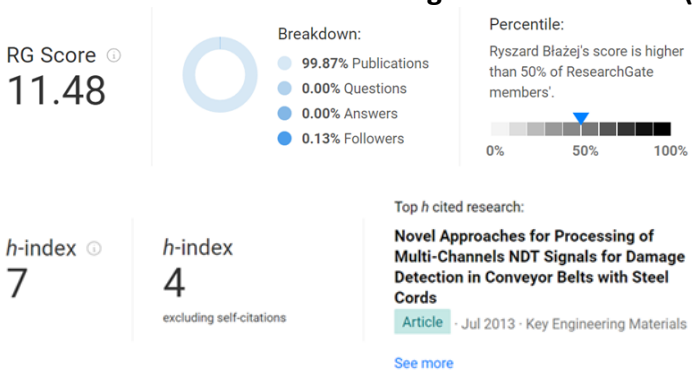
Item	Before Obtaining the Doctoral Degree	After Obtaining the Doctoral Degree	Total
Publications in the JCR-listed journals	0	3	**3**
Monographs	0	1	**1**
Chapters in monographs	0	4	**4**
Publications in foreign journals	0	46	**46**
Publications in Polish journals including in English	9	46	**55**
Publications in foreign conference proceedings (incl. the WoS database)	0	4 (2)	**4**
Publications total	**9**	**101**	**101**
Total points of publications/citations	**0/1**	**637/25**	**637 (+60 Albena,Bulgaria 2017)**

Indicators of scientific achievements

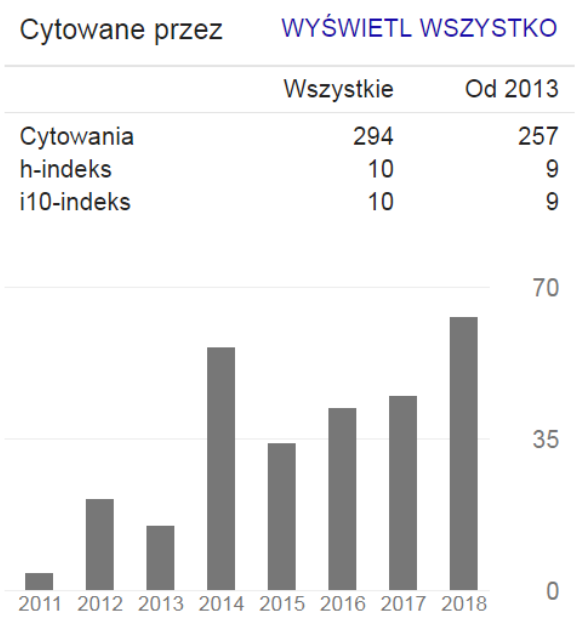
Impact Factor	3.484	**3.484**
Number of citations according to Web of Science	40	**40**
Hirsch Index according to Web of Science	3	**3**
Hirsch Index / number of citations according to Google Scholar	9/287	**9/287**
Hirsch Index according to Scopus	3	**3**



according to Research Gate (Oct. 14, 2018)



according to Google Scholar (Oct. 14, 2018)



according to Publish or Perish

Query	**Ryszard Błażej - Politechnika Wrocławska**
Source	**Google Scholar Profile**
Papers	**74**
Citations	**294**
Years	20
Cites_Year	14.7
Cites_Paper	3.97
Cites_Author	104.55
Papers_Author	23.5
Authors_Paper	3.73
h_index	**10**
g_index	13
hc_index	10
hI_index	3.33
hI_norm	5
AWCR	83.06
AW_index	9.11
AWCRpA	28.28
e_index	6.71
hm_index	5.82
QueryDate	2018-10-14
Cites_Author_Year	5.22
hI_annual	0.25
h_coverage	49.3
g_coverage	58.5
star_count	0
year_first	1998
year_last	2018
ECC	294

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	**2018**
New	1	2	3	4	21	15	56	34	42	45	63
Total	9	11	14	18	39	54	110	144	186	231	**294**