

**Summary of the doctoral dissertation written under the direction of  
prof. zw. dr hab. Jerzy Gołuchowski**

**“Aligning the information and communication technology  
to the cluster's maturity level”**

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A characteristic feature of modern organizations is that they operate in a cooperation network. A specific form of cooperation networks are clusters, which were first described by M. Porter based on earlier research, including that by A. Marshall. According to Porter, clusters are understood as geographic concentrations of interconnected business entities, producers, suppliers of specialized inputs, service providers, companies operating in related industries, and related institutions, competing and cooperating with each other

Whilst there is considerable scientific output describing the phenomenon of clusters, cluster analysis is an area of research that continues to develop dynamically. This stems from the fact that clusters operate in an economy that is increasingly globalised and subject to many pressures (such as a short product life cycle or the constant need to develop innovation). Equally important are the changes resulting from the implementation of the Industry 4.0 concept and the dynamic development of ICT, which have an impact on the operational reality of modern clusters. Since 2020 and the outbreak of the COVID-19 pandemic, they have also become an important tool to counter the economic meltdown and recession, and a way to rebuild industries that have been affected by the crisis.

The dissertation aims to fill the knowledge gap concerning the matching of information technology to the maturity level of the cluster and to fill this knowledge gap in the area of management. Taking into account the different levels of maturity of clusters and processes occurring within them, there is a need for an appropriate selection of IT technologies that can support process improvement and be applied at different stages of cluster development and across different cluster areas. Literature research has demonstrated that this is not only a practical problem, but also a scientific one. Numerous researches have highlighted the importance of knowledge and communication management, trust management and technology management as tools to support the development (improvement) of organisations, but so far they have not provided a satisfactory solution for clusters. Following the literature research it has become apparent that both the offered maturity models developed for a single organisation and the few cluster maturity models do not meet the expectations of managers in terms of testing

the alignment of applied ICT to the maturity level of clusters. The necessity to appropriately match ICT to the maturity level of the cluster became particularly noticeable during the COVID-19 pandemic when all cluster activities were moved to virtual space.

The objective addressed in the dissertation was to develop a methodology for diagnosing the alignment of ICT with the maturity level of clusters. To achieve this objective, not only was it necessary to conduct literature research on clusters, their improvement and their maturity, and on models for assessing their maturity, but also to develop a multidimensional cluster maturity model, which would take into account selected areas of cluster activity depending on the ICT applied. Equally important was to examine its usefulness in assessing the alignment between the level of cluster maturity and the ICT used in the cluster. The development of a multidimensional maturity model has provided tools that have been validated during the research by evaluating selected clusters. The development of a methodology for diagnosing and improving the alignment of ICT in a cluster to its maturity level, based on the application of the developed multidimensional maturity model, has become both a theoretical and methodological challenge.

The dissertation consists of four chapters and its structure reflects the logic of the argument pursued. Chapter 1 describes the phenomenon of clusters and based on a critical review of the literature research, it introduces the specific characteristics of clusters as a network organization. Chapter 2 presents, based on the available literature, the evolution of clusters and management models for their improvement. In the chapter, one examines the issue of life cycle and maturity of clusters, as well as the management of cluster development leading to its maturity and excellence (including key business processes, trust development, knowledge management and communication). Chapter 3 outlines the utilization of maturity models in cluster improvement processes. They have also been subject to a critical review. Following the literature research and needs analysis in the course of participatory observation, a multidimensional cluster maturity model has been proposed and an attempt has been made to evaluate its application in the study of maturity of selected clusters. The model incorporates cluster maturation across three dimensions: (1) business processes, (2) trust development, and (3) knowledge and communication management. The last chapter outlines a methodology for diagnosing the alignment of ICT to cluster processes taking into account the level of cluster development. The methodology incorporates the multidimensionality of cluster development and, consequently, cluster improvement management. The chapter also presents the results of verification of the methodology carried out based on empirical studies with the participation of the executives of selected clusters in Poland. The dissertation concludes with executive

summary reflecting on the relevance of the hypotheses raised in the paper. Furthermore, a number of secondary conclusions and recommendations that have emerged during the course of the research are identified.

Cluster improvement is not a self-sustaining process; it requires to be managed. It is necessary to manage the functioning of the cluster at the operational level, but also to manage its development towards maturity, which takes place at the strategic management level. The dissertation has demonstrated that the effectiveness of cluster management improvement can be influenced by focusing on its key processes. Business processes, trust development, knowledge and communication management are of special significance in the cluster. In order for a cluster to grow and develop, it is therefore necessary to improve these processes so that they reach an increasingly higher maturity level. However, it is imperative to ensure that cluster improvement is managed in such a way that it progresses to a specific goal in logical steps. This has been confirmed by interviews with the representatives of four clusters operating in southern Poland.

What proved helpful in developing a theoretical basis for cluster improvement was the theoretical and practical output related to the implementation of maturity models in organizations and the alignment of IT with business needs, including the clusters' maturity level. With these models, one can actually assess the current level of maturity of an organization and what needs to be done to reach a higher level, which entails that organisation's improved performance. Research in the form of interviews with representatives of the clusters: Silesia Automotive & Advanced Manufacturing, MedSilesia Cluster - the Silesian Network of Medical Devices, Sustainable Infrastructure Cluster, Sinotaic Polish IoT & AI Cluster confirmed that the proposed approach to cluster improvement holds empirical values.

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