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Optimising Project Team Management in the CAD/CAE Engineering Services Sector for the Automotive Industry

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Abstract: Optimising project team management in the CAD/CAE engineering services sector for the automotive industry aims to enhance efficiency and reduce costs in dynamic environments. Building technically skilled, flexible, and cost-effective teams remains a key challenge. This article presents a framework based on qualitative and quantitative research, focusing on leadership, diversity, and technological integration. The study hypothesizes that competence matrices and optimisation solvers improve efficiency and reduce delivery costs. Empirical research at Endego sp. z o.o. confirms the value of balancing team experience with costs to maximize operational performance. The findings highlight the importance of dynamic management, collaboration, and ongoing employee development. Optimisation tools that leverage competency and cost data enable real-time team adjustments, improving results while minimizing expenses. Future improvements, such as integrating live project data and using tools like the Cooperation Grade Matrix to measure team cohesion, are also recommended. Ultimately, investing in advanced optimisation solutions is essential for maintaining flexibility, innovation, and excellence in CAD/CAE project management.

Keywords: optimisation, efficiency, cost reduction, competence matrices, team cohesion

1. Introduction

In the growing engineering services (CAD/CAE) sector of the automotive industry, efficient project team management is essential for success. This study explores strategies for managing dynamic teams, focusing on leadership, diversity, and technological integration to optimise costs and improve efficiency.

Engineering service providers (ESPs) face challenges in building technically proficient, flexible, and cost-effective teams to meet industry demands for innovation and precision. Bridging theory and practice, the study examines tools such as competence matrices and optimisation solvers to enhance team performance, verifying their impact on operational efficiency and cost reduction through empirical analysis.

Using qualitative and quantitative methods, the research investigates leadership styles, team composition, work environments, and technology adoption. It hypothesizes that competence matrices and solvers improve resource allocation and process optimisation, delivering time and cost savings. The study offers practical recommendations and highlights the importance of integrating management theory with real-world applications to advance project efficiency.

2. Project Teams – Building and Managing

Building an Effective Project Team

Building an effective project team goes beyond assembling individuals with complementary skills. It requires strategic selection, cultural alignment, and adaptability to evolving project demands. Defining the project scope and necessary competencies is fundamental. Team members should share common values and bring diverse experiences that enrich team dynamics (Piwowar-Sulej, 2013, p. 47). Strong interpersonal relationships, trust, and open communication are essential and can be fostered through effective leadership and team integration efforts. The team leader acts as a mentor, motivator, and strategist, ensuring alignment with project goals. Additionally, balanced role allocation according to Belbin's team roles model ensures optimal collaboration and responsibility sharing (Belbin, 1981).

The composition of a project team directly affects efficiency, collaboration, and overall success. An optimal team combines technical expertise, problem-solving capabilities, and interpersonal skills. Cross-functional expertise, combining designers, engineers, and project managers, enables comprehensive problem-solving, while a mix of senior and junior members fosters knowledge transfer and innovation. Cultural and cognitive diversity enriches creativity and decision-making, and clearly defined roles minimize confusion and increase accountability.

Diversity in personality traits, work styles, and life experiences boosts creativity and problem-solving (Goleman, 1995). An inclusive environment, built on respectful communication and regular feedback, enhances engagement and productivity (Lencioni, 2002).

Experience also plays a crucial role in project success by enhancing decision-making, communication, and crisis management. Experienced teams navigate challenges effectively and implement innovations with confidence (Meredith & Mantel, 2012; Pinto, 2010).

Leadership and Team dynamics

Leadership style has a significant impact on team dynamics and outcomes. Transformational leaders inspire with vision and innovation (Bass, 1990), transactional leaders focus on structure and rewards (Burns, 2009), and servant leaders build trust by prioritising team needs (Greenleaf, 1977). Democratic leadership fosters participation, while autocratic leadership ensures control in critical situations (Lewin et al., 1939). The appropriate leadership style should align with team maturity, project complexity, and organizational culture.

A team leader is not only responsible for task management but also for mentoring, supporting growth, and guiding strategy. Effective leaders inspire with a clear vision (Sinek, 2009), cultivate trust through open communication (Lencioni, 2002), and adapt their leadership style to the team's needs (Blanchard, 1985), while promoting ethical behaviour and cohesion.

Effective team management also requires understanding the team's development stages, as outlined by Tuckman (1965): forming, storming, norming, performing, and adjourning. Each stage demands specific leadership interventions, from establishing goals and resolving conflicts to fostering autonomy and reflecting on project completion. Psychological safety (Edmondson, 1999), diversity and inclusion (Shore et al., 2011), and flexible leadership support sustainable, high-performing teams.

Balancing Costs, Seniority, and Experience

Balancing costs and seniority is essential to optimising team performance. Senior members provide advanced expertise but incur higher costs, while junior members offer cost-efficiency and growth potential. Combining both enables knowledge transfer and long-term organizational value creation (Chmielewiec, 2019; Lichtarski, 2011). Competency models support effective role allocation, balancing experience and costs (Filipowicz, 2014).

Employing too many junior members increases the need for supervision and quality control, while over-reliance on seniors reduces margins. Mixed teams of juniors and seniors enhance cost-efficiency and performance by leveraging juniors' affordability and seniors' expertise. Proper support for junior employees boosts overall efficiency and sustainability.

Experience directly impacts problem-solving and decision-making capabilities, allowing teams to collaborate effectively, manage crises, and drive innovation. Teams with a balanced structure are better prepared for dynamic project environments, optimising both costs and performance outcomes.

Work Environment and Collaboration

The work environment – whether on-site, remote, or hybrid – shapes team dynamics and performance. Remote work offers flexibility but may lead to isolation, while on-site work improves direct communication but introduces logistical challenges. Hybrid models attempt to balance these advantages but require strong management and communication strategies to maintain cohesion. Regular check-ins, inclusive practices, and attention to team well-being are essential in all environments to ensure seamless collaboration.

Furthermore, diversity of work styles and preferences requires creating a supportive atmosphere that values different approaches. Respectful communication, psychological safety, and continuous feedback contribute to maintaining motivation, innovation, and productivity in diverse and distributed teams.

Technological Integration in Project Team Management

Technology plays a pivotal role in enhancing the efficiency, collaboration, and innovation of project teams. The integration of modern tools supports the management of complex projects and fosters agility.

Key technologies include:

- project management platforms (Jira, Asana, Trello) for task tracking and milestone management;
- collaboration and communication tools (Teams, Slack, Zoom) enabling seamless interaction in remote and hybrid setups;
- cloud-based solutions (Google Workspace, Confluence) that facilitate real-time document sharing and knowledge management;
- Ddata analytics and AI, which support risk prediction, performance tracking, and decision-making (Buxmann & von der Gracht, 2021);
- automation of repetitive processes and Agile workflows (Rigby et al., 2016), allowing teams to focus on high-value tasks.

A well-integrated technological ecosystem enhances transparency, reduces the risk of errors, and ensures better project outcomes. Organizations leveraging advanced solutions such as AI-driven risk assessment, real-time tracking, and collaborative environments achieve higher efficiency and competitiveness.

3. Strategies and Tools for Advanced Project Team Optimisation

Introductory Remarks

Building on the complexities of forming and managing project teams discussed in previous paragraph, this section shifts the focus to advanced strategies for optimising project teams. By leveraging foundational knowledge of team dynamics, we explore holistic approaches, optimisation models, mathematical modelling, and effective use of optimisation tools and techniques.

Challenges and Future of ESP Companies in Building Effective Project Teams

Engineering Service Providers (ESPs) in the automotive industry face ongoing challenges in building effective project teams. They must balance technical proficiency, adaptability, cost-efficiency, and innovation to meet demanding industry standards. Managing complex engineering tasks requires advanced expertise and flexibility to respond to changing project requirements and technological developments.

Cost optimisation is critical, as ESPs must align resource allocation and team structure with profitability without sacrificing quality. At the same time, a strong culture of innovation is essential to meet evolving client expectations and stay competitive in a fast-paced global market.

Strict safety, emissions, and performance regulations add further complexity, requiring deep knowledge of industry standards. Looking ahead, the integration of artificial intelligence, machine learning, and advanced technologies will reshape the sector, pushing ESP teams to continuously upgrade their skills and tools to drive efficiency and innovation.

Holistic Approaches to Optimisation

In today's rapidly changing business environment, a holistic approach to managing project teams is increasingly significant. This strategy emphasises understanding team members' needs and potential, essential for sustained efficiency and innovation (Brassey et al., 2023; Oboloo, 2022).

A holistic view considers employees' mental, physical, and social well-being, enabling managers to harness individual strengths and improve productivity and creativity (Brassey et al., 2023). Investing in well-being – encompassing physical, mental, and emotional health – yields measurable short- and long-term benefits, with healthier employees demonstrating higher productivity.

Unlike traditional approaches focused on short-term results and cost minimization, holistic management integrates methodologies like Total Delivered Cost (TDC), which evaluates true costs, including transportation, storage, and hidden fees (Oboloo, 2022). This comprehensive perspective enhances strategic decision-making and process optimisation.

Companies like Google, SAS Institute, Netflix, and Patagonia exemplify successful holistic practices by prioritising well-being, open communication, and flexible work environments, achieving high employee satisfaction and productivity.

Competence Matrix and Project Teams at Endego

The use of a competence matrix (Tab. 1) is integral to Endego's approach to project team management. This tool helps in identifying the skills and expertise required for each project and matching them with the available resources within the company. By systematically assessing and documenting the competencies of team members,

Table 1. Fragment of Endego skill matrix

Personal Number	Employee name	Role	Leadership	Communication with customers	Cooperation	Proactivity	Problem solving	Project Management	English language	German language	NX Solid	NX Surface	NX Assy	NX 2D Drawing	VW	Audi	Skoda	Mercedes	BMW	Porsche	IP/Miko	Door Panel	Headliner	Pillar trims	Carpets/ Insulations	Trunk
ID1	Dominik Kaczka	Junior	1	1	2	2	1	1	2	1	0	0	0	0	1	1	1	1	1	1	3	2	2	3	2	0
ID2	Monika Łabędź	Junior	1	2	3	3	2	2	3	1	0	0	0	0	3	2	1	1	1	1	2	0	0	1	2	0
ID3	Grzegorz Sokół	Regular	1	2	3	3	2	2	2	1	3	2	3	2	3	3	3	2	2	3	3	3	2	3	2	3
ID4	Piotr Wróbel	Senior	2	2	3	2	3	2	3	2	1	1	3	3	3	3	3	1	2	3	3	2	2	2	1	2
ID5	Aleksander Jeż	Senior	2	3	3	3	3	2	3	1	1	1	2	2	2	3	1	1	2	1	1	1	1	2	2	2
ID6	Damian Wrona	Leader	2	3	4	3	3	3	3	1	1	1	1	1	3	3	3	3	2	3	2	3	1	2	2	3
ID7	Pawel Kos	Leader	3	3	3	2	3	3	3	2	2	2	2	1	3	3	3	1	3	3	3	3	1	2	3	3
ID8	Łukasz Gołąb	Junior	1	2	3	3	3	1	3	2	2	3	2	1	1	1	1	0	3	2	1	1	1	3	2	2
ID9	Mirek Orzeł	Leader	2	4	3	3	3	3	3	3	1	1	1	1	4	4	4	2	3	2	3	2	4	3	3	4
ID10	Ola Wrona	Junior	1	2	3	3	2	1	3	2	3	3	3	3	1	1	1	3	1	1	4	2	2	2	1	2

Source: own elaboration.

Endego can ensure that the right people are assigned to the right projects. The competence matrix also aids in identifying skill gaps and areas for development. This allows for targeted training and development initiatives, ensuring that team members continuously enhance their capabilities and stay abreast of the latest industry trends.

Optimisation Models

Optimisation models are essential for improving project team efficiency, helping identify the best solutions under specific constraints through mathematical and algorithmic methods (Hillier & Lieberman, 2001). Integrated with team management strategies, they support goal achievement while maintaining employee satisfaction and well-being.

Types of Optimisation Models

- Linear Programming (LP): used in production planning, supply chain management, and resource allocation.
- Nonlinear Programming (NLP): applied in advanced engineering, economics, and finance.
- Integer Programming (IP): relevant for logistical planning, project management, and scheduling problems.
- Dynamic Programming (DP): effective in sequential optimisation, resource management, and game theory.

Each type has specific applications and requires appropriate solution methods (Bertsimas & Tsitsiklis, 1997). These models are widely applied across industries, from engineering and economics to logistics, medicine, and environmental protection, enabling efficient resource use and problem-solving.

Mathematical modelling further enhances optimisation by analysing and predicting complex phenomena (Bevington & Robinson, 2003; Karnopp, 1990; Ross, 2014; Varian, 1992). Models can be deterministic, stochastic, dynamic, or static and are increasingly hybrid, combining various techniques for more robust analysis. Applications range from weather forecasting and disease modelling to technological innovation and financial markets (Black & Scholes, 1973; Feynman et al., 1964; Kitano, 2002; Lorenz, 1963).

Ensuring model reliability in complex environments is challenging, driving the adoption of artificial intelligence and machine learning to create adaptive solutions (Bengio et al., 2015). Future directions include real-time optimisation, cloud computing, and quantum computing, which further expand the potential of optimisation techniques.

Optimisation Solvers

Optimisation solvers are essential tools for addressing complex decision-making challenges in fields such as engineering, logistics, IT, and project management. By applying advanced algorithms – based on linear, nonlinear, and integer programming, as well as heuristic and metaheuristic methods – solvers support efficient resource allocation, scheduling, and system design.

Their key advantage lies in the ability to analyse multiple variables and constraints simultaneously, enabling the selection of optimal team compositions, cost structures, and work plans. In project management, solvers help compare alternative scenarios, balance workloads, and predict the impact of different configurations on overall performance and profitability.

With increasing project complexity, computational efficiency becomes critical. Modern solvers use technologies such as parallel and cloud computing to process large datasets quickly and accurately. Additionally, the growing integration of artificial intelligence and machine learning enhances solver adaptability, allowing real-time adjustments to project changes and improving the accuracy of predictions (Bengio et al., 2015).

In dynamic environments like the automotive industry, optimisation solvers play a strategic role, enabling companies to respond faster to evolving client needs, manage resources effectively, and maintain high-quality standards while controlling costs.

4. Endego sp. z o.o.: Innovation and Challenges in Project Team Management

Introductory Remarks

This section delves into the specific challenges and innovative strategies employed by Endego sp. z o.o. in managing project teams within the CAD/CAE engineering services sector of the automotive industry. By examining the company's approach, this analysis aims to provide insights into effective team management practices, the role of innovation, and the unique challenges faced by engineering service providers (ESPs).

Company Endego sp. z o.o.

Endego sp. z o.o., based in Krakow, Poland, provides comprehensive engineering and software development services for the automotive industry, delivering end-to-end solutions from concept to market. The company specialises in designing vehicle interiors and exteriors with a focus on aesthetics, functionality, safety, and aerodynamics. In collaboration with leading European OEMs, Endego develops automotive lighting, electrical installations, and embedded electronics, utilising programming languages such as C Embedded/MISRA, C++, and Java. Additionally, the CAE team performs advanced simulations – including structural, CFD, and electromagnetic analyses – to optimise designs and reduce costs. Combining technical expertise with strong project management capabilities, Endego delivers innovative, reliable solutions to meet the industry's demanding standards.

To address diverse client needs, Endego applies flexible cooperation models. The Time & Material model supports dynamic projects with evolving scopes, ensuring transparency and cost control, while the Work Package Delivery model focuses on clearly defined deliverables and milestones, facilitating precise planning and resource allocation. Tailoring these approaches enables Endego to manage projects efficiently while maintaining high client satisfaction.

Endego builds effective project teams by leveraging modern methodologies such as Agile and Lean, which enhance collaboration, efficiency, and adaptability. The company promotes innovation through access to advanced tools and encourages open communication and experimentation. Prioritising psychological safety, diversity, and inclusion creates an environment where team members feel valued and empowered, driving creativity and high performance. By continuously integrating emerging technologies and responding to industry trends, Endego strengthens its competitive advantage while consistently delivering high-quality engineering solutions.

5. Optimisation: Results and Their Interpretation

Optimisation at Work: Evaluating Project Team Strategies at Endego

The preceding section examined how project team optimisation can enhance the dynamic environment of the automotive industry. This paragraph focuses on assessing the effectiveness of these optimisation strategies, evaluating how they translate into measurable business outcomes, and deriving lessons from these results.

The analysis will involve a detailed examination of Endego's results using analytical tools and mathematical models introduced earlier. This will help identify critical success factors and areas for further optimisation. Consequently, this section bridges theoretical exploration and practical application in a real-world business setting, offering valuable insights and recommendations for future initiatives.

Purpose of the Task

The goal is to determine the optimal composition of the project team by analysing the competences and costs of employees. The input data include:

- skill matrix with designated specific competences depending on the project (Tab. 2);
- project parameters (man hours, area, OEM, required foreign language, capacity plan for individual months, etc.; Tab. 3).

Table 2. Project skill and seniority matrix

Personal Number	First name	Role	Competence Center	Rate (PLN)	Weekly (40 h) costs (PLN)	Project Language	Project CAD Competence	Project Industry Competence	Industry Competence Bonus	OEM Expertise	Project Management	Competence & Seniority	Role in project	Employee Presence
ID1	Dominik Kaczka	Junior Engineer	Interior	50.00	2 000.00	0	8	4	2	1	0	24	DE	YES
ID2	Monika Łabędź	Junior Engineer	Interior	50.00	2 000.00	3	8	2	0	1	0	21	DE	YES
ID3	Grzegorz Sokół	Regular Engineer	Exterior	75.00	3 000.00	0	11	5	5	2	0	36	DE	YES
ID4	Piotr Wróbel	Senior Engineer	Exterior	90.00	3 600.00	3	12	4	2	2	0	37	DE	YES
ID5	Aleksander Jeż	Senior Engineer	Interior	90.00	3 600.00	3	12	1	1	2	0	22	DE	YES
ID6	Damian Wrona	Project Leader	Interior	110.00	4 400.00	3	14	3	2	2	3	41	**PL**	YES
ID7	Pawel Kos	Project Leader	Interior	90.00	3 600.00	3	12	5	5	3	3	55	**PL**	YES
ID8	Łukasz Gołąb	Junior Engineer	Exterior	50.00	2 000.00	3	11	1	1	3	0	21	DE	YES
ID9	Mirek Orzeł	Project Leader	Interior	110.00	4 400.00	3	13	5	5	3	3	56	**PL**	YES
ID10	Ola Wrona	Junior Engineer	Exterior	55.00	–	3	1	5	2	1	0	35	**N/A**	YES
ID11	Justyna Kos	Regular Engineer	Exterior	75.00	–	0	10	1	1	2	0	11	**N/A**	YES
ID12	Marcin Gołąb	Regular Engineer	Exterior	75.00	3 000.00	3	11	4	4	2	0	36	DE	YES
ID13	Maciej Orzeł	Senior Engineer	Interior	85.00	3 400.00	3	10	6	6	2	0	55	DE	YES
ID14	Przemek Wrona	Senior Engineer	Exterior	85.00	3 400.00	3	13	1	1	3	0	23	DE	YES
ID15	Grzegorz Kos	Project Leader	Exterior	110.00	4 400.00	0	11	5	5	4	3	45	DE	YES

Source: own elaboration.

Table 3. Project basic capacity plan for optimisation

Month	M1	M2	M3	M4	M5	M6	M7
Empl./month for optimisation	0.5	4	1.5	3.5	2	0.5	0.25
Working hours/month	80	640	240	560	320	80	40

Source: own elaboration.

Key competence indicators:

- Project Language: knowledge of the language is crucial, with values considered only if equal to or greater than 3;
- Project CAD Competence: assesses CAD skills, essential for design engineers;
- Project Industry Competence: experience in designing a given part or module, enhanced by an Industry Competence Bonus;
- OEM Expertise: knowledge of OEM standards, processes, and tools;
- Project Management: skills in managing projects in each area.

Mathematical Model and Representation of the Optimisation Task

To achieve cost minimisation and maximise team ranking, the optimisation model integrates multiple variables and constraints reflecting real-world project requirements and team dynamics.

Mathematical Model with Cost Minimisation

The primary goal is to minimise project costs (Scenario 1) while maintaining appropriate experience and seniority levels. The model uses data from 15 individuals with varying levels of expertise and weekly costs (Tab. 2). Ranking points, reflecting the competence and seniority of each team member, are calculated to determine their suitability for the project.

The optimisation model was implemented in Excel Solver, determining the participation level of each employee (0-4 units).

Mathematical Model to Maximise Team Ranking

The second model focuses on maximising team ranking (Scenario 2) by optimising the competence levels of team members while keeping costs within budgetary constraints.

CEPI Maximisation

CEPI (Composite Employee Performance Index) maximisation (Scenario 3) involves fine-tuning team compositions to enhance overall performance, considering both competence and cost.

Example of Project Completed at Endego and Optimisation Attempts

A case study of a completed project at Endego showcases the application of the optimisation models. The project (Tab. 4) spanned seven months, with the optimisation model adjusted to reflect real-world conditions.

Table 4. Project – basic project data/parameters

Project Hours budget (h)	1960
Time (months) – W	7
Working time (h/month)	160
OEM	BMW
Competence Centre	Interior
Part/Module	IP/Miko
CAD	Catia
Language	English
Customer rate	PLN 149.60
Project expected revenue	PLN 293 216.00

Source: own elaboration.

Scenario 1: Maximise the Gross Margin (GM1)

In this scenario, the aim is to maximise the project margin while maintaining a balanced team. The Solver identified a team composition of 1 Project Leader, 1 Senior Design Engineer, and 2 Junior Design Engineers. The high involvement of juniors results in a potentially high margin, though it introduces a risk due to their lesser experience (Tab. 5).

Results:

- Revenue: PLN 293 216.00;
- COGS: PLN 98 088.80;
- GM1: 67%.

Table 5. Results of Scenario 1

				Empl./ month for optimisation		0.5	4	1.5	3.5	2	0.5	0.25
				Working weeks	49	2	16	6	14	8	2	1
				Working hours	1960	80	640	240	560	320	80	40
Role	Competence & Seniority	Role in project	Employee Presence	Project Employee COGS (PLN)	Sum of Employee Working units	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7
Regular Design Engineer	45	DE	YES	–								
Regular Design Engineer	36	DE	YES	–								
Regular Design Engineer	35	DE	YES	–								
Junior Design Engineer	24	JUN	YES	–								
Junior Design Engineer	18	JUN	YES	–								
Junior Design Engineer	22	JUN	YES	9 600.00	8		**4**		**4**			
Junior Design Engineer	21	JUN	YES	17 000.00	17	**2**	**4**	**2**	**4**	**4**		**1**
Junior Design Engineer	27	JUN	YES	–								
Junior Design Engineer	22	JUN	YES	–								
Senior Design Engineer	37	DE	YES	–								
Senior Design Engineer	30	DE	YES	–								
Senior Design Engineer	50	DE	YES	49 888.80	18		**4**	**2**	**4**	**4**	**2**	
Senior Design Engineer	31	DE	YES	–								
Project Leader	74	PL	YES	–								
Project Leader	56	PL	YES	21 600.00	6		**4**		**2**			

Source: own elaboration.

Scenario 2: Maximise Team Seniority

This scenario focuses on forming the most competent team. The team includes 2 Project Leaders, 1 Senior Design Engineer, and 1 Regular Design Engineer. This results in a lower margin but ensures higher team competency and potentially faster project completion (Tab. 6).

Table 6. Results of Scenario 2

				Empl./ month for optimisation		0.5	4	1.5	3.5	2	0.5	0.25
				Working weeks	49	2	16	6	14	8	2	1
				Working hours	1960	80	640	240	560	320	80	40
Role	Competence & Seniority	Role in project	Employee Presence	Project Employee COGS (PLN)	Sum of Employee Working units	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7
Regular Design Engineer	45	DE	YES	29 140.80	8		**4**		**4**			
Regular Design Engineer	36	DE	YES	–								
Regular Design Engineer	35	DE	YES	–								
Junior Design Engineer	24	N/A	YES	–								
Junior Design Engineer	18	N/A	YES	–								
Junior Design Engineer	22	N/A	YES	–								
Junior Design Engineer	21	N/A	YES	–								
Junior Design Engineer	27	DE	YES	–								
Junior Design Engineer	22	N/A	YES	–								
Senior Design Engineer	37	DE	YES	–								
Senior Design Engineer	30	DE	YES	–								
Senior Design Engineer	50	DE	YES	45 080.00	14		**4**	**2**	**4**	**4**	**2**	
Senior Design Engineer	31	DE	YES	–								
Project Leader	74	PL	YES	117 003.60	21	**2**	**4**	**4**	**4**	**4**	**2**	**1**
Project Leader	56	PL	YES	21 600.00	6		**4**		**2**			

Source: own elaboration.

Results:
- Revenue: PLN 293 216.00;
- COGS: PLN 212 824.40;
- GM1: 27%.

Scenario 3: Maximise the Cost-Effectiveness Performance Indicator (CEPI)

This scenario combines employee ranking with cost to find the most cost-effective team. Two sub-scenarios were considered: 3a and 3b.

Scenario 3a includes at least 50% Junior Design Engineer involvement (Tab. 7).

Table 7. Results of Scenario 3a

				Empl./ month for optimisation		0.5	4	1.5	3.5	2	0.5	0.25
				Working weeks	49	2	16	6	14	8	2	1
				Working hours	1960	80	640	240	560	320	80	40
Role	Competence & Seniority	Role in project	Employee rate (PLN)	Cost-Effectiveness Performance Indicator (CEPI)	Sum of Employee Working units	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7
Regular Design Engineer	45	DE	91.07	0.49								
Regular Design Engineer	36	DE	92.15	0.31								
Regular Design Engineer	35	DE	93.75	0.30								
Junior Design Engineer	24	N/A	42.86	0.56								
Junior Design Engineer	18	N/A	53.57	0.39								
Junior Design Engineer	22	N/A	30.00	0.63	4				**4**			
Junior Design Engineer	21	N/A	25.00	0.84	21	**2**	**4**	**4**	**4**	**4**	**2**	**1**
Junior Design Engineer	27	DE	58.94	0.32								
Junior Design Engineer	22	N/A	32.00	0.59								
Senior Design Engineer	37	DE	69.29	0.43	4		**4**					
Senior Design Engineer	30	DE	112.50	0.27								
Senior Design Engineer	50	DE	80.50	0.62	14		**4**	**2**	**4**	**4**		
Senior Design Engineer	31	DE	80.00	0.48								
Project Leader	74	PL	139.29	0.53								
Project Leader	56	PL	90.00	0.62	6		**4**		**2**			

Source: own elaboration.

Results:

- Revenue: PLN 293 216.00;
- COGS: PLN 103 566.40;
- GM1: 65%.

Scenario 3b excludes Junior Design Engineers (Tab. 8).

Table 8. Results of Scenario 3b

				Empl./ month for optimisation		0,5	4	1,5	3,5	2	0,5	0,25
				Working weeks	49	2	16	6	14	8	2	1
				Working hours	1960	80	640	240	560	320	80	40
Role	Competence & Seniority	Role in project	Employee rate (PLN)	Cost-Effectiveness Performance Indicator (CEPI)	Sum of Employee Working units	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7
Regular Design Engineer	45	DE	91.07	0.49								
Regular Design Engineer	36	DE	92.15	0.39								
Regular Design Engineer	35	DE	93.75	0.37								
Junior Design Engineer	24	N/A	42.86	0.56								
Junior Design Engineer	18	N/A	53.57	0.34								
Junior Design Engineer	22	N/A	30.00	0.73								
Junior Design Engineer	21	N/A	25.00	0.84								
Junior Design Engineer	27	DE	58.94	0.46								
Junior Design Engineer	22	N/A	32.00	0.69								
Senior Design Engineer	37	DE	69.29	0.53	14		**4**	**2**	**4**	**4**		
Senior Design Engineer	30	DE	112.50	0.27								
Senior Design Engineer	50	DE	80.50	0.62	21	**2**	**4**	**4**	**4**	**4**	**2**	**1**
Senior Design Engineer	31	DE	80.00	0.39								
Project Leader	74	PL	139.29	0.53	8		**4**		**4**			
Project Leader	56	PL	90.00	0.62	6		**4**		**2**			

Source: own elaboration.

Results:
- Revenue: PLN 293 216.00;
- COGS: PLN 172 595.20;
- GM1: 41%.

Conclusions from the Optimisation Scenario Analysis

Balancing skills, experience, and cost in project teams are key to achieving efficiency. Employing too many juniors risks quality and increases supervision, while relying solely on seniors reduces margins. The CEPI (Cost-Effectiveness Performance Indicator) effectively balances these factors, optimising team composition. Mixed teams of juniors and seniors enhance cost-efficiency and performance by leveraging juniors' affordability and seniors' expertise. Proper support for young employees boosts efficiency, and the CEPI model shows potential for broader application by integrating competencies and costs.

Challenges include the subjectivity of evaluating competencies, static models' limitations in dynamic environments, and overlooked human factors like motivation and relationships. To address these, dynamic management tools, fostering collaboration, and investing in employee training are recommended. An integrated approach, combining economic and interpersonal factors, is essential for creating effective, adaptable teams and achieving sustainable optimisation.

6. Conclusions

This article explores optimising project teams in the automotive CAD/CAE sector, highlighting study insights and future pathways for research and application. It confirms the strategic value of competence matrices and optimisation solvers in enhancing operational efficiency and reducing project delivery costs, supported by empirical data.

Key Findings

The study validated that integrating theoretical models with practical applications improves team performance. Leadership styles, team composition, technological integration, and work environment emerged as key factors influencing project outcomes. Competence matrices and solvers proved instrumental in enhancing efficiency and cost-effectiveness.

Strategic Recommendations

- Cooperation Grade Matrix: a proposed tool to quantitatively assess interpersonal relationships and team cohesion, enhancing communication in high-stakes projects.
- Enhanced Optimisation Solvers: incorporating real-time project data and feedback ensures dynamic refinement, adaptability, and continuous improvement.

Future Directions

Organizations should invest in advanced solvers integrating competence matrices and the Cooperation Grade Matrix to foster continuous improvement and innovation. Regular updates with new performance data ensure solvers remain effective in real-world scenarios. This work provides a foundation for further research into advanced tools and strategies for project team management, promoting efficiency and innovation in the CAD/CAE sector.

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Optymalizacja zarządzania zespołami projektowymi w sektorze usług inżynieryjnych CAD/CAE dla przemysłu motoryzacyjnego

Streszczenie: Optymalizacja zarządzania zespołami projektowymi w sektorze usług inżynieryjnych CAD/CAE dla przemysłu motoryzacyjnego ma na celu zwiększenie efektywności i redukcję kosztów w dynamicznych środowiskach. Budowanie zespołów o wysokich kompetencjach technicznych, elastycznych i efektywnych kosztowo pozostaje kluczowym wyzwaniem. Niniejszy artykuł przedstawia ramy teoretyczne oparte na badaniach jakościowych i ilościowych, koncentrujące się na przywództwie, różnorodności i integracji technologicznej. Badanie pozwala postawić hipotezę, że matryce kompetencji i solvery optymalizacyjne poprawiają efektywność i redukują koszty realizacji. Badania empiryczne przeprowadzone w Endego sp. z o.o. potwierdzają wartość równoważenia doświadczenia zespołu z kosztami w celu maksymalizacji wydajności operacyjnej. Wyniki podkreślają znaczenie dynamicznego zarządzania, współpracy i ciągłego rozwoju pracowników. Narzędzia optymalizacyjne wykorzystujące dane o kompetencjach i kosztach umożliwiają dostosowania zespołów w czasie rzeczywistym, poprawiając wyniki przy jednoczesnej minimalizacji wydatków. Zalecane są również przyszłe ulepszenia, takie jak integracja danych projektowych na żywo i wykorzystanie narzędzi, takich jak Macierz Stopnia Współpracy, do pomiaru spójności zespołu. Inwestowanie w zaawansowane rozwiązania optymalizacyjne jest niezbędne dla utrzymania elastyczności, innowacyjności i doskonałości w zarządzaniu projektami CAD/CAE.

Słowa kluczowe: optymalizacja, efektywność, redukcja kosztów, matryce kompetencji, spójność zespołu