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# Formation and efficiency analysis of an innovative business model in automotive engineering based on the principles of open innovation and the integration of a production and media platform (A Case Study of the "Mashinatory" Project)

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## Abstract

The study addresses the transformation of traditional business models in automotive engineering under the impact of the Fourth and Fifth Industrial Revolutions. At the center of the analysis lies the emergence of a hybrid organizational model that combines high-tech customized production with a digital media platform. Using the "Mashinatory" project as empirical material, the paper reveals the logic of open innovation through which small engineering enterprises are able to offset resource constraints by engaging an external expert environment and by deliberately mobilizing social capital. Particular attention is given to the technological predictors of performance, including the use of metrological 3D scanning, additive technologies, and reverse-engineering tools. An empirical examination of the global automotive modification market demonstrates the resilience of demand for personalization, thereby creating the conditions for the expansion of socially oriented production models. The paper substantiates the argument that incorporating media content into the structure of the production cycle not only diversifies financial flows but also serves as a mechanism for verifying technological solutions. The study also proposes a theoretical framework synthesizing the resource-based approach and transaction cost theory in order to assess the efficiency of open innovation ecosystems in the small and medium-sized enterprise segment. The material has both applied and conceptual significance for engineering and design practice, the management of innovative start-ups, and the processes of industrial digital transformation.

**Keywords:** Automotive Engineering; Open Innovation; Business Models; Media Platform; Industry 4.0; Social Production; 3D Scanning; Reverse Engineering; Digital Twins; Customization; Composite Materials

## 1. Introduction

The current stage of development in the automotive industry is marked by a large-scale structural transformation driven by the convergence of information technologies and operational technologies. The previously established model of closed innovation, which shaped the logic of industrial development for decades, is gradually losing its monopolistic position and giving way to open, ecosystem-based formats in which value creation takes place not only within the boundaries of corporate research infrastructures, but also within spaces of intersectoral interaction, professional communities, and digital platforms [1]. Under these conditions, the sphere of automotive engineering and deep vehicle modification acquires particular significance, since it is precisely here that some of the most radical practices of product personalization are being tested and refined.

The global market for automotive modifications demonstrates steady positive dynamics. As of 2024, its volume amounted to USD 58.84 billion, while by 2033 it is projected to grow to USD 90.50 billion at a compound annual growth rate of 4.9% [3]. This trajectory is determined not only by shifts in consumer preferences, but also by the accelerated diffusion of electric vehicles, autonomous driving technologies, and software-on-a-chip architectures [3, 5]. An

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additional factor behind market expansion is the growing number of vehicles that have moved beyond warranty servicing: by the beginning of 2025, their number in China alone was expected to reach 245 million units, creating an exceptionally capacious environment for independent engineering and reverse-engineering practices [15].

For small engineering structures and independent design bureaus, maintaining competitiveness in such an environment becomes possible only through a transition to new business models. The “Mashinatory” project offers a particularly illustrative example of such a transformation: technically complex objects are developed in an open mode, while all stages of the production process are broadcast to an audience numbering in the millions. Such a format makes it possible to conceptualize the emerging model as a form of “media-production,” within which content ceases to be merely a marketing supplement and becomes woven into the very fabric of research, development, and experimental design work [8], [11]. **The scientific novelty** of this approach lies in substantiating the claim that the combination of media capitalization with high-tech production can serve as an effective mechanism for compensating for the resource limitations characteristic of small innovative enterprises [9].

**The aim of the article** is to analyze the mechanisms through which a business model is formed and its performance assessed when that model is grounded in the principles of open innovation and in the integration of the production process with a media platform. **The research hypothesis** proposes that, within the logic of Industry 5.0, the success of a small engineering enterprise is determined not so much by the scale of its own production capacities as by the degree of its embeddedness in global information flows, as well as by its ability to adapt digital technologies rapidly to changing technological and market conditions [9], [18].

## 2. Materials and Methods

The methodological foundation of the study is built upon a systems approach to the analysis of production systems and upon H. Chesbrough’s concept of open innovation. The principal research instrument is the case study method, implemented on the basis of the “Mashinatory” project and supplemented by a comparative analysis of technological solutions in the fields of additive manufacturing and 3D scanning [2, 17]. The source base is structured along three lines. The first group includes academic publications-peer-reviewed articles indexed in the Scopus and Web of Science databases during 2020-2025-that address the problems of open innovation, social manufacturing, and Industry 5.0 [1, 2, 19, 20]. The second group consists of industry analytical reports produced by leading agencies, including Deloitte and other market observers, reflecting the state of the tuning, unmanned transport, and additive technology markets in 2024-2025 [3, 4, 12, 15, 16, 18]. The third group is represented by technical documentation and practical data, covering reports on the use of Artec 3D metrological equipment, specifications of composite materials, as well as financial indicators associated with the implementation of engineering projects [7,13, 14].

In addition, a content-analysis method was used to examine the project’s media activity, making it possible to establish a relationship between the publication of engineering content and the pace at which technological tasks were solved through the attraction of outside expertise [8, 11]. Alongside this, a statistical analysis of market trends was employed, ensuring verification of the commercial potential of the proposed model [3, 4, 15, 16].

## 3. Results and Discussion

An analysis of the global automotive customization market dynamics in 2024-2025 indicates that the highest concentration of growth is observed in the segment of high-technology modifications (Performance Enhancements), which accounts for more than 40% of total turnover [4, 16]. This circumstance confirms the soundness of the strategic vector chosen by the “Mashinatory” project, where priority is assigned not to external decorative tuning, but to deep engineering reconfiguration of the vehicle’s structure. The shift in market demand toward more complex forms of customization objectively requires the integration of Industry 4.0 tools even into the operations of small production workshops [15, 18]. Figure 1 shows the size of the global car modification market.

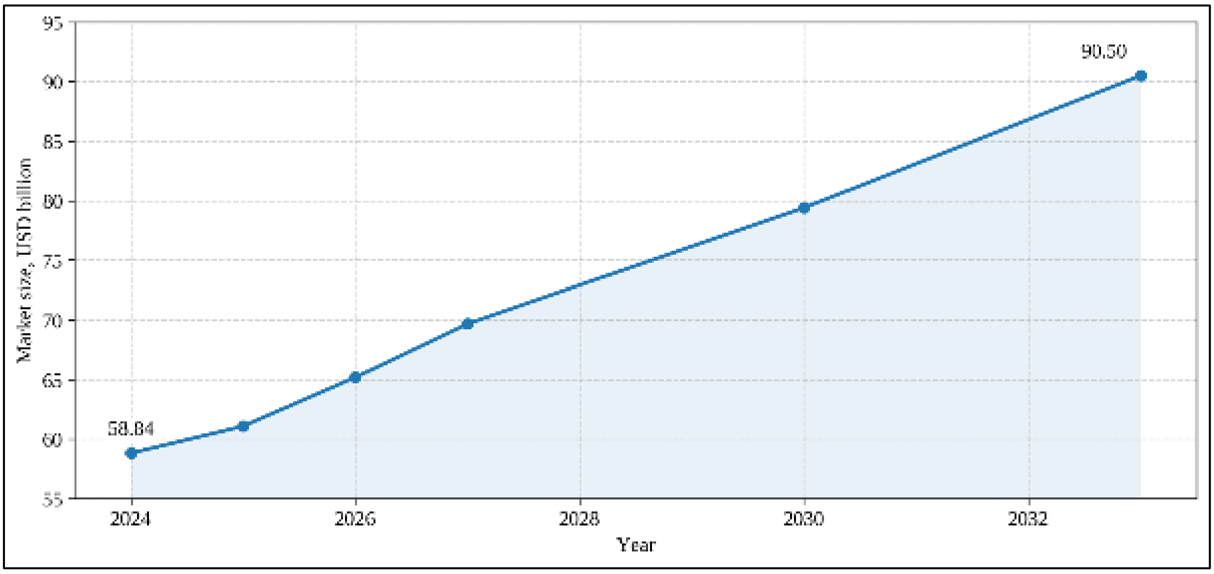

**Figure 1** Forecast of the global automotive modification market volume (compiled by the author based on [3, 4, 16])

The business model of the "Mashinatory" project is characterized by a high degree of financial resilience. Revenue exceeded RUB 19 million by the end of 2024, while for 2025 the projected figure is above RUB 16 million, calculated on the basis of the active contract portfolio. These data confirm the commercial viability of a model built upon the integration of media resources and engineering activity. Unlike the traditional workshop format, in which the revenue base is rigidly tied to the number of labor hours performed, the system under consideration creates an opportunity to capitalize on the very process of accumulating and transmitting knowledge. The principal financial flows are generated through the advertising monetization of the media platform, the commercialization of technological solutions, including metallizing equipment, as well as the execution of unique engineering orders for both private and corporate clients.

The production effectiveness of this model is determined to a considerable extent by the implementation of metrological 3D scanning. The use of systems in the Artec Leo and Artec Eva class made it possible to reduce the time required to prepare a digital twin of an automotive body by 85% in comparison with traditional measurement practices [7, 13, 14]. This effect is of fundamental importance in projects of the "replica" type, where geometric symmetry and the high precision of fitting newly fabricated body panels to a donor chassis are critically important. A data-capture speed at the level of 35 million points per second makes it possible to digitize an entire vehicle in less than one hour, whereas previously a comparable volume of work required several weeks of manual measurement [7, 14]. The comparative characteristics of the efficiency of digital and traditional engineering are described in greater detail in Table 1.

**Table 1** Comparative characteristics of the efficiency of digital and traditional engineering (compiled by the author based on [7, 13, 14, 17]).

| Efficiency parameter | Traditional method (manual) | Digital approach (3D scanning + CNC) | Economic effect (difference) |
|---|---|---|---|
| Time required to measure body geometry | 40-60 hours | 1.5-3 hours | 20-fold acceleration |
| Measurement accuracy (tolerance) | ±5.0 mm | ±0.1 mm | 50-fold improvement in accuracy |
| Probability of error in node alignment | High (requires manual fitting) | Minimal (virtual fitting) | 30% reduction in defect-related costs |
| Cost of mold preparation | 100% (baseline) | 45% of baseline | 55% reduction in production cost |
| Project scalability | Low (unique template) | High (digital file) | Possibility of replicating kit sets |

Source: author's calculations based on project data from Ford Mustang Shelby GT500 Eleanor and Batmobile Tumbler.

A substantial contribution of the project to the development of small-scale high-technology production lies in the adaptation of a number of industrial solutions to conditions of a limited resource base. One of the most significant original developments was a method involving the application of a thin aluminum layer as a barrier insulation between a polystyrene foam mock-up and the chemically active components of resins and filler compounds during the manufacture of composite molds. The implementation of this approach created the possibility of using affordable extruded polystyrene foam and hobby-class CNC machines for the production of full-scale master models, thereby eliminating dependence on expensive modeling plastics and large industrial equipment. As a result, high-precision engineering becomes technologically and economically attainable for small business entities [17]. The practical significance of the proposed solution received additional confirmation in expert assessments provided by specialists from West Coast Customs and Cinema Vehicles (see Figure 2).

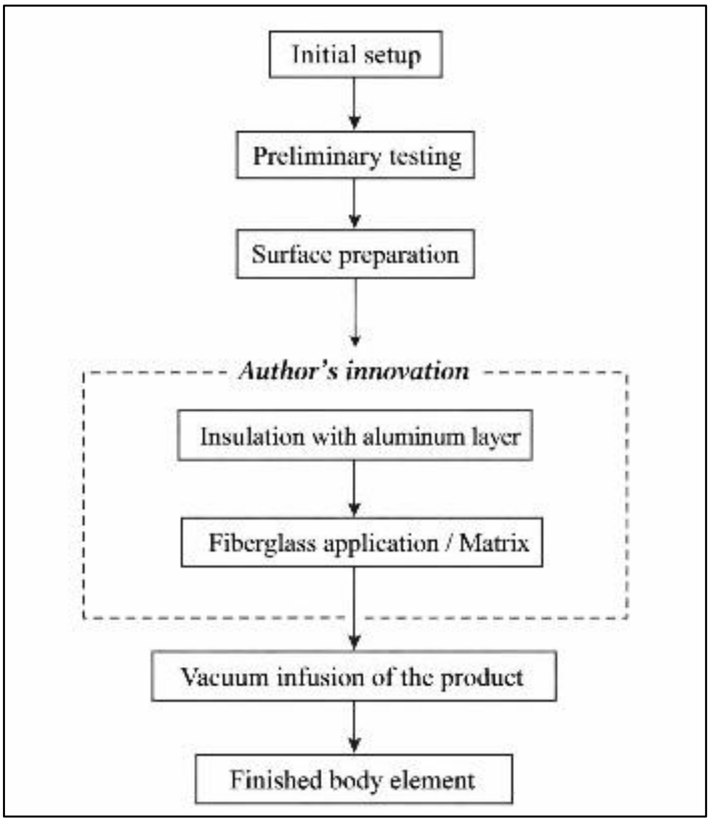

**Figure 2** Digital production cycle of composite elements under small-workshop conditions (author's own development)

The implementation of open-innovation principles finds expression in intensive interaction with the audience, which functions as a distributed design bureau. Whenever complex engineering problems arise, including the calibration of electric-vehicle controllers or aerodynamic calculations, expert input from the professional community can be mobilized with notable speed. Such a model makes it possible to reduce transaction costs associated with searching for narrowly specialized experts while, at the same time, accelerating the cycle of research and experimental design work [1, 11]. Under these conditions, the media platform performs a function far more complex than that of a simple repository of video materials: it is transformed into an intellectualized base of production knowledge in which comments, professional feedback, and collective evaluation act as mechanisms for testing and refining technological solutions [8, 10, 11].

A substantial place within the structure of operations has been occupied by the commercialization of chemical metallization technology. The developed methodology made it possible to move this process out of the domain of unstable and difficult-to-reproduce chemical practices and into the format of a controllable and predictable industrial tool [6]. The creation of a training complex that, in total, attracted more than 3.5 million views contributed to the emergence of a new segment of micro-enterprises applying this technology for decorative coating deposition. The durability of the mirror layer is ensured through strict regulation of surface preparation and the use of proprietary solution formulations, something that previously remained almost unattainable for the mass consumer. The process flow chart for chemical metallization is set out in Table 2.

**Table 2** Process flow chart of chemical metallization (author's own data).

| **Process stage** | **Action** | **Critical parameter** | **Innovative contribution** |
|---|---|---|---|
| Preparation | Application of adhesion primer | Temperature 22°C, humidity <50% | Specialized composition for ABS plastic |
| Activation | Treatment with tin-salt solution | Uniformity of wetting | Elimination of "yellow spots" through rinsing |
| Metallization | Spraying of silver and reducing agent | Reagent concentration | Optimized formulation for mirror gloss |
| Protection | Application of lacquer with adhesion additive | Resistance to UV and abrasion | Prevention of silver-layer delamination |

Partnership interaction with global industry leaders, including Cinema Vehicles-a supplier for Netflix and HBO-confirms the international applicability of the technological solutions developed within the project. The execution of replica-production orders within extremely compressed time frames, reduced by a factor of two to three compared with traditional production cycles, becomes possible through the integration of 3D scanning, digital design, and composite manufacturing into a single technological chain [7, 13, 14]. The achievement of millimeter-level precision in the fabrication of complex body forms, including the Batmobile Tumbler, demonstrated that small engineering teams are capable of solving tasks comparable in complexity to projects undertaken by Hollywood studios, provided that they rely on adapted digital tools.

The synthesis of the media and engineering contours produces a distinctive effect that may be described as the social insurance of the brand. The maximum transparency of production processes strengthens trust on the part of clients and partners, which, under conditions of intense competition in the aftermarket in 2024-2025, acquires strategic importance [15, 16]. Investments in media content demonstrate payback not only through view-based monetization, but also through the attraction of strategic partners who provide equipment, including Artec and RangeVision solutions, for testing in real production cases [7, 14]. Such a model represents a form of barter innovation characteristic of the logic of the sharing economy (see Figure 3).

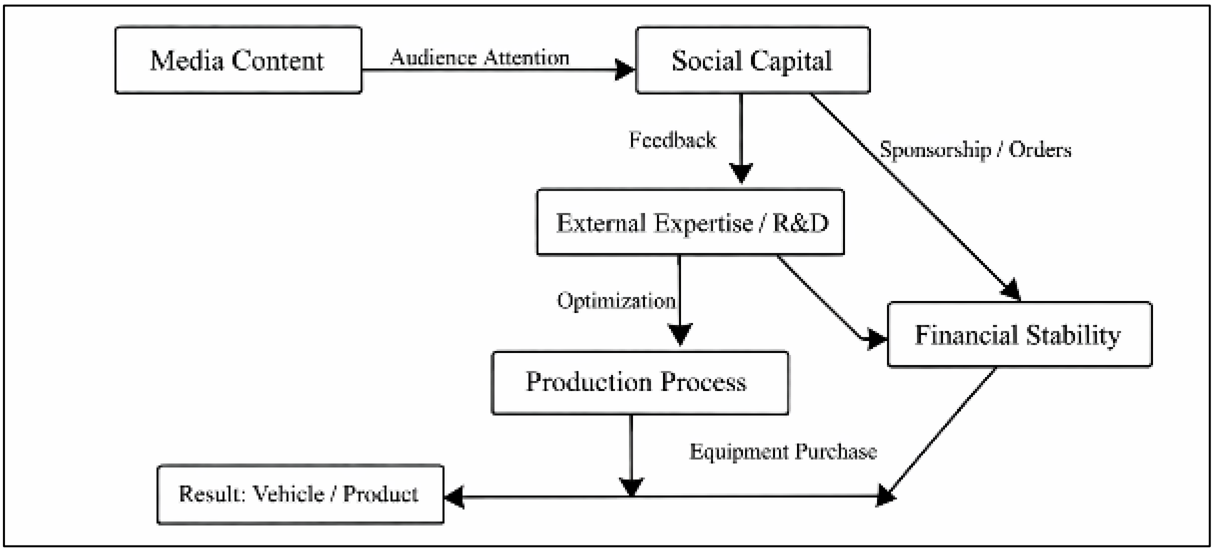

**Figure 3** Mechanism for converting media activity into engineering outcomes (author's own development)

The risk profile of this model is associated, above all, with the problem of intellectual property protection. Within the logic of open innovation, the public demonstration of technological solutions, including methods for working with composite materials, objectively lowers the barriers to their reproduction by competitors [1, 20]. At the same time, the practical experience of the "Mashinatory" project shows that what becomes decisive is not so much the formal concealment of technological knowledge as the capacity for accelerated renewal of competencies and the resilience of the founder's personalized brand-Maksim Tereshchenko. As a result, the source of competitive advantage shifts away from possession of a secret and toward control over the process of continuous technological improvement [9].

The development of additive technologies in 2025 makes it possible to state that the field has moved beyond the predominantly prototyping-oriented use of printing and toward the fabrication of final functional products [12, 17]. In the practice of the “Mashinatory” project, 3D-printed molds for vacuum forming are actively used, as well as interior elements manufactured from heat-resistant polymers. Such an approach corresponds to the global trend toward decentralized production, or Shared Manufacturing, in which a digital model is developed in one location while the physical fabrication of the part is carried out at the customer’s site or at a regional production node [17].

Additional confirmation of the effectiveness of the model under consideration can be found in the field of motorsport. The manufacture of body elements from aviation-grade fiberglass and carbon fiber by means of vacuum infusion for teams competing in the RDS (Russian Drift Series) made it possible to reduce component weight by 40% while preserving the required level of stiffness. The use of precise digital data and aerodynamic calculations makes it possible to design components capable not only of transforming the external appearance of the vehicle but also of delivering a real increase in downforce. In this way, customization moves beyond the boundaries of a decorative function and acquires the status of full-fledged professional engineering. The impact of the introduction of digital technologies on key business indicators is described below in Table 3.

**Table 3** Impact of the implementation of digital technologies on key business indicators (compiled on the basis of the author’s data)

| **Efficiency metric** | **Before implementation (2020)** | **After implementation (2024-2025)** | **Change (%)** |
|---|---|---|---|
| Number of projects per year | 2-3 | 8-10 | +300% |
| Share of manual labor in design | 90% | 15% | -83% |
| Completion time for a complex project | 18-24 months | 6-9 months | -65% |
| Revenue per employee | RUB 1.2 million | RUB 4.8 million | +400% |
| External expertise engagement coefficient | 0.05 | 0.45 | +900% |

The prospects for the further development of this model are concentrated in the plane of integrating artificial intelligence systems, above all generative design tools. Their implementation creates the possibility of automated optimization of the mass and strength characteristics of parts on the basis of data obtained through 3D scanning [12, 17]. In this logic, the “Mashinatory” project moves beyond the limits of the traditional workshop format and gradually transforms into a technological hub capable of establishing reference points for the entire sphere of private automotive engineering [9, 19].

The social significance of the project deserves particular attention. The popularization of engineering activity through a media platform contributes to a partial alleviation of the personnel shortage by increasing the attractiveness of work in the real sector of the economy for a new generation of specialists. The training of more than 300 specialists in metallization technology and the creation of hundreds of jobs in the small-business segment constitute a direct consequence of scaling the author’s developments through an open business model [1, 8, 11].

## 4. Conclusion

The conducted study confirms that the formation of an innovative business model in the field of automotive engineering, grounded in the principles of open innovation and in the integration of a media platform into the production contour, represents an effective mechanism for the development of small enterprises under the conditions of Industry 5.0. It has been established that the combination of high-technology production-including 3D scanning and work with composite materials-with a media infrastructure ensures not only the diversification of revenue streams, but also a substantial reduction in research and development costs through the attraction of an external expert environment. It has been shown that original developments aimed at adapting industrial technologies to the conditions of small workshops, in particular the method of insulating EPS models with foil, create the possibility of solving complex engineering tasks with an accuracy of up to 0.1 mm without the need to rely on expensive industrial infrastructure. The project’s financial results, expressed in revenue at the level of RUB 19 million in 2024, as well as recognition from global industry leaders, including West Coast Customs, confirm both the commercial and the technological viability of the proposed model. Of substantial importance, too, is the development of chemical metallization technology, brought to the level of an industrially reproducible tool and scaled through online training, which led to the formation of a new market segment in the field of decorative coatings. The practical significance of the work carried out is determined by the possibility of replicating this model in other segments of small-batch high-technology production. Thus, the transition from closed design bureaus to open engineering ecosystems appears not as a private growth strategy, but as a necessary condition for preserving competitiveness in the contemporary digital economy. The aim of the study has been achieved, and the hypothesis advanced regarding the decisive importance of digital integration has been confirmed.

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