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2022, 2023, 2024, 2025

InTraCoM Group
Intellectual Property Solutions

Patent-Valuation Report

Patent portfolio valuation of patent family WO2023220537
„Simple and linear fast adder“

for

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performed by
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Content

1. Disclaimer

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InTraCoM GmbH guarantees that the work has been carried out in good faith and according to the highest technical and methodological standards.

Liability claims against InTraCoM GmbH, which refer to material or immaterial nature caused by the use or disuse of any information provided through the use of incorrect or incomplete information, are generally excluded.

2. Confirmation of objectivity within the scope of the evaluation activities

InTraCoM confirms that it has no interest or intention to acquire an interest in the assets of the patent holder that are the subject of this valuation.

InTraCoM has no personal interest in any of the parties involved or any other intention that could compromise an independent valuation.

Remuneration is not dependent on the outcome and findings of the valuation.

3. Value determination method

The valuation was carried out using the indicator-based market analogy method. In this method, all patents and utility models are analysed by taking into account various fixed indicators, using mathematical algorithms and interdependencies. The method uses up to 27 indicators for fully automated patent valuation (Autorating). A publication number must be available. In order to obtain an accurate value prediction, up to 66 additional indicators can be rated manually using valuation-scope-specific questionnaires (Optionrating). The indicators cover the Assignee, Environment, Technology and Legal areas of each IP. The value calculation is based on reference values of previously traded patents (market analogy approach) that have a similar indicator pattern to the patent being valued (reference values).[1].

The calculated values reflect an external market view of the patent portfolio. **This means that they do not necessarily correspond to income values.**

The market analogy approach also strongly considers the maturity of a patent. Patents that are nearing the end of their life (i.e. where the remaining period of exploitation is 12 months or less) lose value disproportionately. This takes into account that a patent that is to be sold needs a certain amount of time to be transferred and ultimately used by a potential buyer.

[1] Kiehne, D.-O.: Automated patent valuation: background and main questions; Stuttgart, 02.2016; http://www.media.intracomgroup.de/WP-Patentvaluation_with_indicators.pdf

4. Starting situation and valuation scope

The indicator-based market approach has been applied (fair market analogy), i.e. patents are considered to be a tradable commodity. It is expressly noted that the patent valuations are based on a number of assumptions, that the values are subject to dynamic fluctuations (e.g. due to changes in the environment, different legal situations, etc.) and that they will expire at the latest after their maximum term.

Additionally, the following assumptions were taken for valuing the patent portfolio:

1. All delivered patents are still owned by the same owner and have not lapsed, e.g. due to non-payment of fees.

2. Applications older than 10 years that have not resulted in a granted patent remain alive in the family but are not considered to have been used. Their value is therefore downgraded. This means that a much higher value will be assigned once they are granted.

3. When evaluating ungranted applications or unpublished inventions, it is important that all selected features have been correctly chosen and that the invention, for example, does not correspond to the state of the art, is also inventive and technical and meets all other requirements that do not preclude general patentability.

4. The assignee has selected the various options in the manual evaluation as shown in the Appendix. It is assumed that the characteristics that ultimately determine the value prognosis within the indicator-based market analogy are all correct and applicable.

5. The valuation was initiated by the customer for investor relations or any other monetization activities.

5. Valued family

The following patent (family) was valued:

WO2023220537A1

„SIMPLE AND LINEAR FAST ADDER"
priority date: 2022-05-11
Patent family ceases latest[2]: 2043-05-02 (as long as the US term is not extended due to terminal disclaimer)

Correspondingly, the patent family **is young and in perfect exploitation age.**

a) Patent claims

The invention is represented by 15 claims[3], thereof **1 independent claims[4]**.

First and main claim:

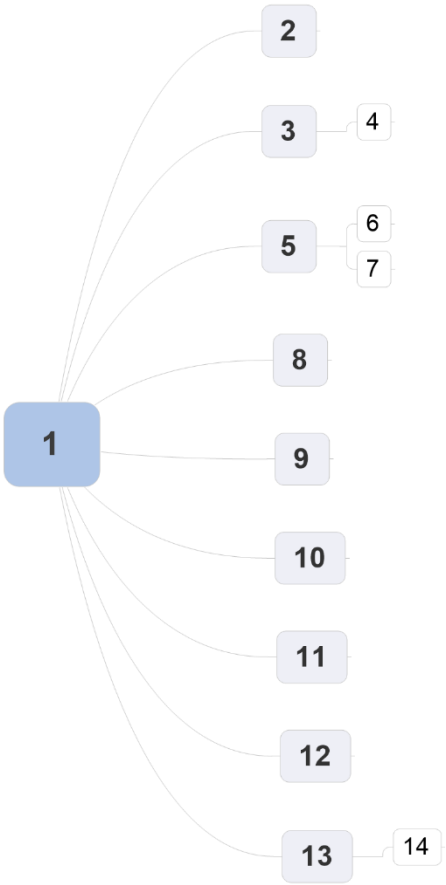
A linear fast adder for an Arithmetic Logic Unit (ALU), the adder comprising: a) a four-bit adder component comprising a plurality of logic gates comprising at least sixteen AND gates, four XOR gates; and b) a plurality of one-bit registers; wherein the four-bit adder is configured with a linear area, linear complexity and a logarithmic delay; and wherein the four-bit adder has a constant gate depth thereby resulting in constant power dissipation.

[2] "Ceases latest" means the latest expected date of lapse on which the last family member expires. when all fees have been paid, the patent has not been abandoned, has not been rejected during the grant proceedings, and has not been previously cancelled during opposition, invalidity, or other proceedings. The date refers to the latest anticipated expiry-date of a patent in the family
[3] When analysing claims, it was tried to access the latest possible procedural status where published claims were available. This means, for example, that if there was an already granted patent in the family of applications, the claims of that grant were used for the claim analysis, as there may be visible limitations in the claim breadth and it is likely that other examiners will also follow the assessment and also limit the claims.
[4] An independent claim is a self-contained claim that defines the broadest scope of an invention without relying on other claims. It stands alone and includes all essential features necessary for defining the invention. In contrast to that, a dependent claim refers back to an independent (or another dependent) claim and adds additional limitations, features, or refinements to further specify the invention. It cannot stand alone and is narrower in scope.

The claim has 3 essential claim features[5]:

1. **Main Components:**
    i. A **four-bit adder component**, comprising:
        1. **At least sixteen AND gates**.
        2. **Four XOR gates**.
    ii. A **plurality of one-bit registers**.
2. **Architectural Properties:**
    i. The **four-bit adder** is configured with:
        1. **Linear area**.
        2. **Linear complexity**.
        3. **Logarithmic delay**.
3. **Power Performance:**
    i. The **four-bit adder** has **constant gate depth**.
    ii. This results in **constant power dissipation**.

Hierarchical claims structure:



[5] Claim features are considered in the context of potential patent infringement. For infringement to occur, all claim features must be present in the infringing product or process. Therefore, the fewer claim features a patent has, the easier it may be to prove infringement, potentially resulting in a stronger blocking effect.

b) invention summary

The invention presents a general-purpose, high-speed adder implemented as a sequential logic circuit based on a finite state machine (FSM). Unlike traditional adders (Ripple Carry, Carry Look-Ahead), this adder replaces carry propagation logic with a novel mathematical model using set-based binary arithmetic, resulting in:

- Linear area and linear complexity scaling with input bit length.
- Logarithmic time delay on average for addition operations.
- Constant instruction set, independent of bit size.
- Constant gate depth, enabling predictable power consumption.

The adder processes binary numbers as sets of powers of two, leveraging XOR gates for symmetric difference and AND gates for intersection operations. These are iteratively processed through registers until a stable state is reached (no carry remains), which yields the final sum.

Key hardware characteristics:

- Per-bit architecture with 1 XOR, 4 AND gates, and 4 one-bit registers.
- Easily extensible to n-bit adders by chaining 4-bit subunits.
- Supports signed numbers and rational approximations (fixed/floating point).
- Additional capability for left/right shift (multiplication/division by 2).
- Adaptable to three-operand addition, like a carry-save adder.

The FSM-based control allows efficient hardware implementation, and its modular nature enables high-speed, low-power operation, making it ideal for CPUs, embedded systems, and power-sensitive processors.

c) possible applications

1. Arithmetic Logic Units (ALUs) in CPUs

- Primary application: The adder is designed specifically to serve as a core component in ALUs.
- Impact: Enhances arithmetic speed and reduces power consumption, especially important in compact and efficient processor design.

2. Embedded Systems

- Suitable for microcontrollers and ASICs that require low-power, deterministic, and area-efficient designs.
- Its small gate count, predictable delay, and fixed instruction set make it ideal for firmware-controlled applications.

3. Digital Signal Processing (DSP) Units

- Applicable in add-intensive algorithms (e.g., convolution, filtering).
- The logarithmic delay and parallelism potential offer performance gains in real-time signal processing.

4. Scientific and Engineering Computation

- Can be extended for rational and real number arithmetic, suitable for:
  - Floating/fixed-point calculations
  - Simulation engines
  - FPGA-based computation models

5. Graphics Processing Units (GPUs) and AI Accelerators

- Beneficial in parallel vector operations (SIMD), where many adders operate simultaneously.
- The area and power efficiency enables denser adder integration on silicon.

6. Low-Power Computing & IoT Devices

- Ideal for battery-powered or energy-harvesting devices where minimal power dissipation is crucial.
- Supports moderate processing needs in a deterministic time frame.

7. Custom Hardware for Cryptography

- Certain cryptographic primitives (e.g., ECC, modular arithmetic) rely heavily on fast addition.
- The FSM-based arithmetic model may offer predictable execution paths, important for side-channel resistance.

8. Educational Tools and Demonstrators

- The novel set-theoretic model of arithmetic offers a teaching aid for understanding logic design, number theory, and FSMs.

d) Citations, Oppositions, Invalidity suits

The International Search Report discloses no "X-citations"[6] (documents that are of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone) nor "Y-citation". There are only patents cited that are generally describe the state of the art. The invention so far only consists of applications, so no official examinations have yet been carried out during the granting procedure that would reveal citations and thus proximity to the documented state of the art.

e) State of the art

In summary, it can be assumed that the invention is well differentiated to any prior art.

[6] Where a document cited in the European search report is particularly relevant, it is indicated by the letter "X" or "Y". Category "X" is applicable where a document is such that when taken alone, a claimed invention cannot be considered novel or cannot be considered to involve an inventive step. Source: European Patent Office https://new.epo.org/en/legal/guidelines-epc/2023/b_x_9_2_1.html

f) Dependencies on third-party IPR

The invention contains features of a foreign patent in force, however, an unrestricted license agreement for the utilisation of the foreign right is according to the client in force or available.

Furthermore, there are no known indications of an infringement of property rights, so that there are no circumstances that would reduce the value.

g) Invention share

The share of the invention in a possible product is given as 51-66%.

h) Family structure:

The family (family definition: Equivalents) has at the date of expertise the following alive members:

- **WO2023220537A1** (application)
- **CN119678130A** (application)
- **KR20250020455A** (application)
- **IN202417097720** (unpublished application, according to INPO receipt letter, delivered by client)
- **CA3253057** (unpublished application, according to CAIPO receipt letter, delivered by client)
- **SG11202407900T** (unpublished application, according to IPOS receipt letter, delivered by client)
- **GB2418125.7** (unpublished application, according to GBIPO receipt letter, delivered by client)
- **US18864662** (unpublished application, according to USTO receipt letter, delivered by client)
- **EP** (unpublished application according to WIPO legal states information, no application number available yet. So far, during application phase all EPA contract states are covered until the validation- or opt-in phase after grant)
- **JP** (unpublished application according to JPTO receipt letter, delivered by client)

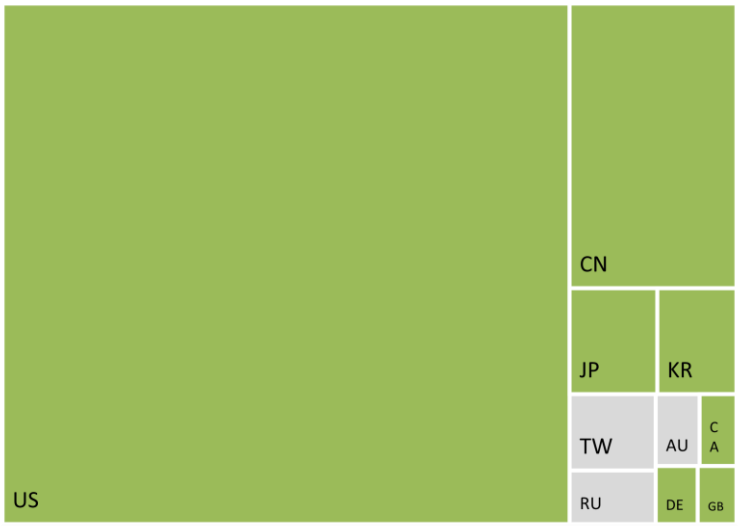
This covers a huge part of the world's economies. The calculated market coverage in the class[7] G06F7 (Methods or arrangements for processing data by operating upon the order or content of the data handled) is more than 94%[8].

[7] The classification is based on the IPC main class, which is determined by the patent office for a patent.
[8] The calculated market coverage considers the respective market size (gross national product) and the technology relevance (number of patent applications in the same class in the respective country).

The following table shows **only the top 10** of the most relevant markets.

Top 10 most relevant markets

Country	Market relevance
US	**75,1%**
CN	**12,1%**
JP	**2,4%**
KR	**2,1%**
TW	1,7%
RU	1,2%
AU	0,8%
CA	**0,7%**
DE	**0,6%**
GB	**0,6%**



6. Works performed

The inventions were valued manually using a multiple-choice questionnaire provided by InTraCoM GmbH. Hereby the different fields of
- Assignee
- Environment
- Technology
- Legals

were covered.

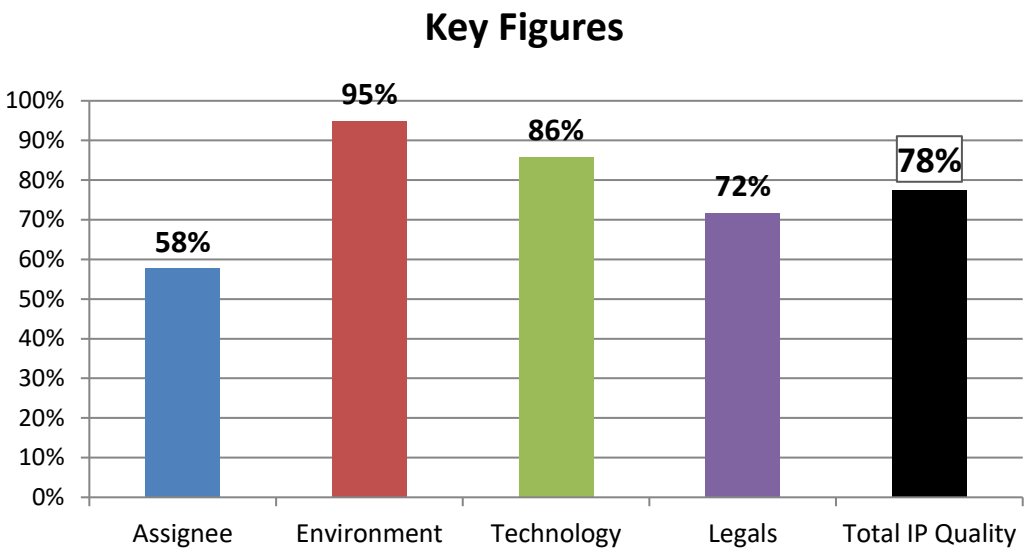
The values were calculated on the basis of the indicator-based market analogy described in 2, with a total of up to 91 indicators available. 27 different indicators were collected automatically by analysing the bibliographic data, business data and market information - if a publication is available. Up to 66 additional indicators can be defined by manual evaluation of the patents, which in this case was done by the client's employee. In this case, 60 characteristics were evaluated (see Appendix).

7. Key figure analysis

The key figures[9] resulting from both the manual (option rating) and the automated (auto rating) analysis provide a qualitative assessment of the patent families and are listed below for each patent family. The individual key figures are also briefly explained below.

[9] The percentages refer to a theoretically possible 100% value.

The qualitative analysis of the invention results in a „Total IP Quality" of 78%, a very good value:



Assignee Key figure:
The assignee score includes the turnover class of the company as well as the R&D ratio (inventions per employee) and the number of inventors involved (automatic analysis). It also takes into account aspects such as the reliability of the IPs' production costs, the main reason for filing, market accessibility or influence on standards.

Environment Key figure:
The environment score is made up of market attractiveness (size and change in size over the years) and market coverage (relevance of markets for a particular technology and size of economy) from the automated analysis. Manual scoring takes into account aspects such as innovation cycles, technology relevance - 'is it fashionable', purchasing power (return on sales) in a given industry or barriers to entry.

Technology Key figure:
The technology score takes into account factors such as proximity to the state of the art or relevance to other companies and other technologies. For example, citations, oppositions and foreign cited-bys (foreign patents not filed by the same assignee as the analysed patents) are automatically taken into account. The manual evaluation considers aspects such as technical feasibility and timeliness, technology investment requirements, ability to exclude various competitors, degree of innovation or the functional share of the invention in a (potential) product.

Legals Key figure:
Various legal aspects are taken into account, such as the number of different claims, especially independent claims. The automatic analysis also takes into account the remaining term, the number of dropped patents within a family or the legal status. The manual evaluation takes into account aspects such as the type

and scope of the prior search, citations, the outcome of the examination or the infringement of third party intellectual property rights.

Total IP Quality

The Total IP Quality score is an overall score made up of all the other scores. It can be seen as a general indicator of the quality of a patent.

8. Value determination

The value is determined using a market value analogy method, i.e. the key figures and indicators presented are compared with reference data from traded patents in the past[10]. This was based on the above families, their members and their procedural status. It was assumed that neither parts of the patent, in particular the claims, nor the patent as a whole would be limited in their validity in the course of further opposition proceedings. However, the valuation reflects the grant risk of the patent family (the patent family is in an early application stage where none of the family members is granted so far) through the application of risk-adjusted discounts.

Considering the number of features used and the available bibliographic data, the quality of this valuation can be considered good and reliable.

Estimated value range for the family:

4,942,000 € - 7,381,000 €

or

$5,372,000 - $8,023,000

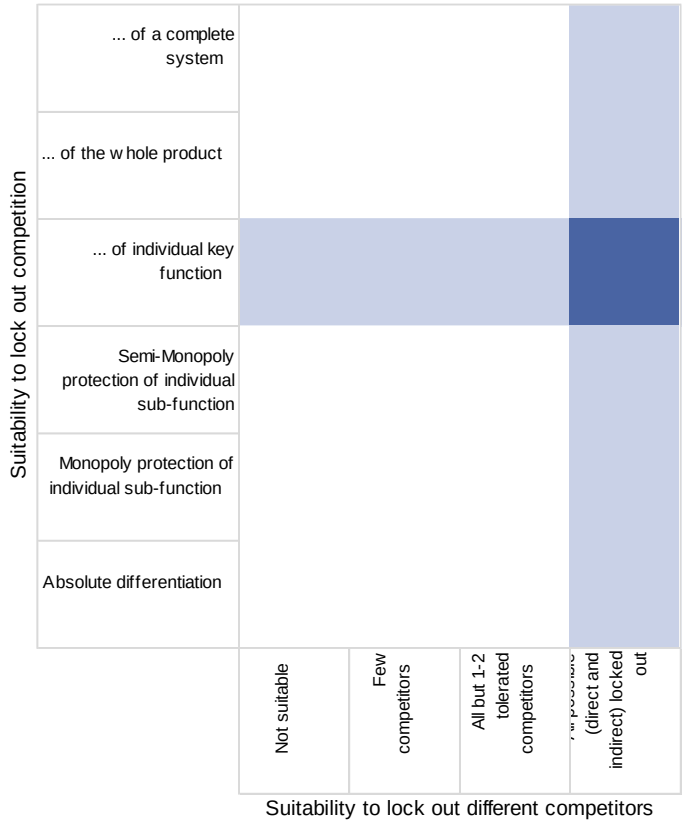
All values were rounded to full 1,000.

[10] The calculation is based on referenced market values (analogies), i.e. market values obtained in the past for patents with comparable characteristics in transactions involving patents (and applications) (reference values). See also: Kiehne, D.-O.: Automated patent valuation: background and main questions; Stuttgart, 02.2016; http://www.media.intracomgroup.de/WP-Patentvaluation_with_indicators.pdf

9. Qualitative comparison of certain characteristics that were chosen

The following qualitative graphs show a set of selected options in the invention under study and their interaction. The graphs are set up like portfolios: the best combination of options is at the top right of each graph.

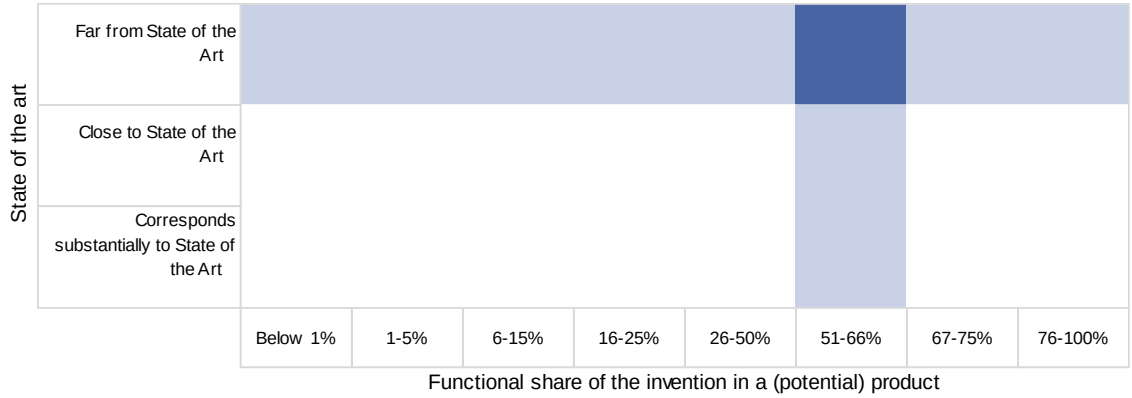
Suitability to Lock Out Competition vs.
Suitability to Lock Out Different Competitors:



Explanation:

If a patent has a high blocking effect on an entire product or system, rather than on a specific function, it provides broader protection and significantly increases the strategic value of the patent. If the blocking effect is also high and excludes as many competitors as possible instead of just a few, the patent becomes a powerful tool for market control. This allows the patent holder not only to secure market share, but also to effectively block potential competitors, resulting in a stronger monopoly and a more sustainable competitive advantage. This maximizes the economic value of the patent.

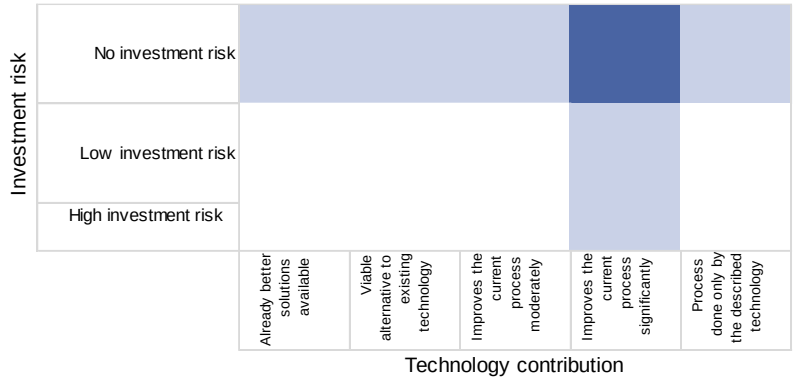
State of the art vs functional share



Explanation:

A patent with a large distance from the prior art can represent a significant technological innovation that gives the owner a strong market advantage and they are often more attractive to investors and potential licensees. They not only offer protection against imitators, but also the opportunity to open up new markets or dominate existing markets. A patent that represents a significant innovation compared to the prior art can usually claim a broader scope of protection. This means that the patent is less susceptible to circumvention as the claims cover a wider range of technology. Patents that stand out strongly from the prior art are also less susceptible to invalidity actions, and applications are more likely to be granted. And the bigger the functional share of the invention on a product is, the better: the higher the total license revenues, for example.

Investment Risk vs. Technology Contribution:

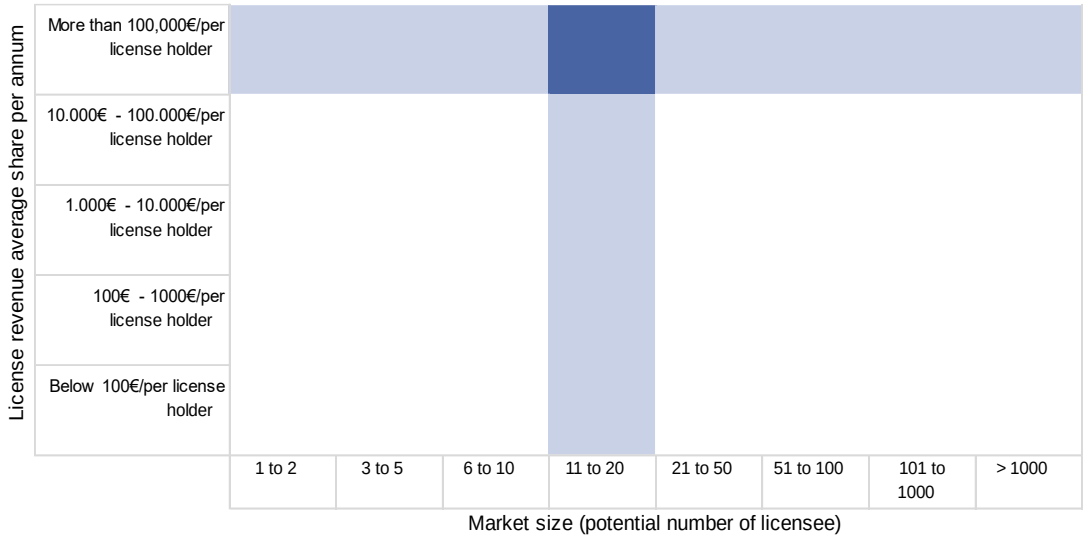


Explanation:

A low investment risk combined with a high technology contribution is important because it is an attractive combination for investors and companies. A high technology contribution signals innovation and market potential, while a low risk increases the likelihood that the investment will be successful and amortize quickly.

This leads to a stronger market position and increases the chances of long-term commercial success.

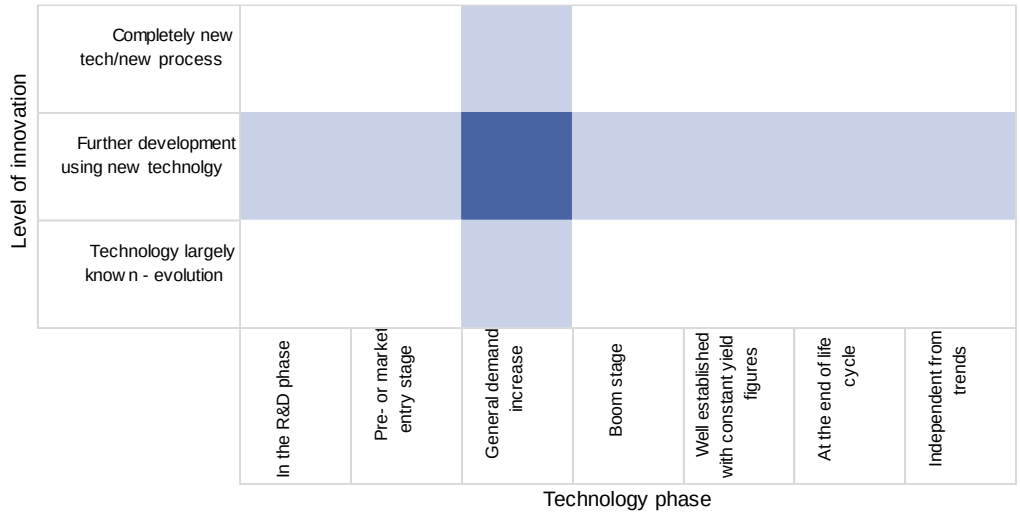
License Amount vs. Market Size:



Explanation:

A patent license with a high royalty rate and a large number of potential licensees maximizes the financial return from the patent. A high royalty increases the direct economic value, while a large number of potential licensees increases the chances of realizing that revenue many times over. This results in a stable and scalable revenue stream that significantly increases the overall value of the patent and ensures a strong long-term return on investment.

Level of Invention vs. Technology Phase:

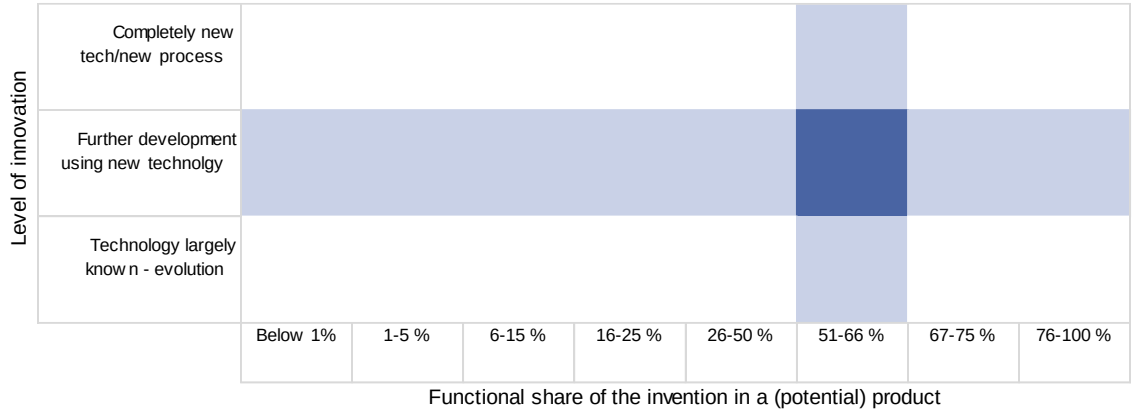


Explanation:

A high level of innovation that is revolutionary rather than evolutionary is important because it significantly increases market opportunities and growth potential. Revolutionary innovations often create entirely new markets or transform existing ones, resulting in a unique competitive position that is difficult for competitors to imitate.

If this innovation hits a market that is currently booming, or is independent of trends, commercial success is maximized. A booming market offers fast growth and high demand, while a market-independent approach ensures stability and long-term relevance. This combines high returns with low risk and creates sustainable value.

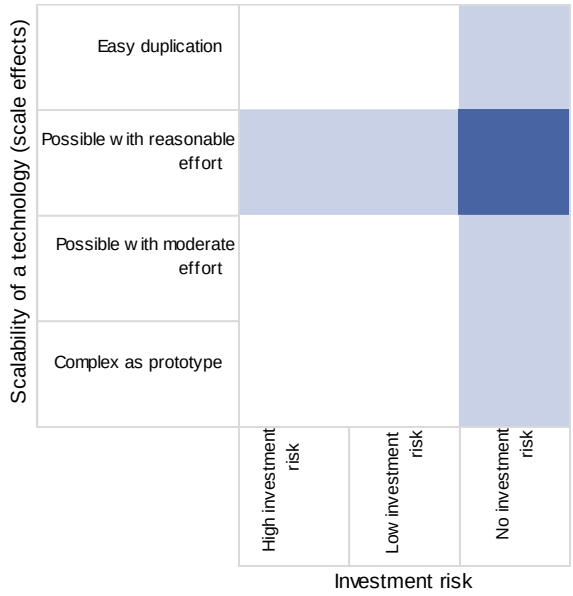
Level of Invention vs. Functional Share of the Product



Explanation:

It is important to have a high level of innovation, i.e. a revolutionary invention, while covering a large share of the product, as this maximizes market dominance and commercial success. A revolutionary innovation often creates a significant competitive advantage and differentiation, making it difficult for others to copy. Moreover, if this innovation is a large part of the product, the overall value and success of the product is strongly determined by the invention. This increases the importance and influence of the patent, leading to higher sales potential, better licensing opportunities and a stronger market position. Correspondingly, a large functional contribution also increases the blocking effect.

Scalabilty vs. Investment risk



Explanation:

If high economies of scale are achieved with the invention and at the same time the investment risk remains low, then profitability and competitiveness increase considerably. The production costs per unit decrease the more is produced, which leads to higher profit margins. At the same time, the low investment risk minimizes the financial risk and increases the probability of a quick return on investment (ROI). This maximizes commercial success by ensuring cost-efficient production and financial security.

10. Appendix: Characteristics of the invention

Category	Characteristic	No.	Answering option
KO criteria for IFRS activation	Reliability of IP production costs	1.1.3	Direct allocation of development costs to the invention
	Resource dependencies	1.2.2	Technology has low resource dependency
	Commercial use	1.3.5	Legal requirements and market conditions for exploitation are extensively provided
	Main reason for application	1.4.5	The goal of the invention is to maximize commercial exploitation.
	Applicant's intent for use	1.5.2	Internal use of the invention in own products possible, but not necessarily foreseen
	Technical feasibility and timeliness	1.6.5	Technical feasibility demonstrated
Applicant	Technology investment requirements	2.1.1	Implementation of the invention requires special know-how and/or special, expensive and proprietary processes and infrastructure.
	Transfer of know-how from seller through patent transfer	2.2.2	Applicant provides additional knowledge for patent/license allocation
	Market dominance	2.3.2	Applicant has some influence
	Influence e.g. standards	2.4.2	The applicant is informed about the development of standards (in the area of the invention) and is directly involved in this process.
Scope of protection	Suitability for standards (formal or informal)	3.1.4	Technology is well suited for the establishment of a standard
	Core or portfolio patent	3.2.3	The patent is a core patent
Blocking effect	Ability to exclude various competing	4.1.4	All possible (direct and indirect) competitors are excluded
Blocking intention	Suitability to exclude competition	4.2.3	Monopoly protection of individual key functions against competitors
Technology	Invention is the result of core competencies (versus serendipitous invention)	5.1.5	Part of applicant's core competencies and top 10 projects
	R&D intensity of the technology	5.2.3	Assignment of an above-average R&D investment rate to the given patent
	Investment risk	5.3.3	No investment risk
	Functional share of the invention in a (potential) product	5.5.6	51-66%
	Level of innovation	5.6.2	The described invention is a further development of a given application, but using completely new technologies/processes.
	Scalability of a technology (economies of scale)	5.7.3	Duplication of technology/application/process possible with reasonable effort

Category	Characteristic	No.	Answering option
Technology	Technology Phase	5.8.3	The technology or application is experiencing a general increase in demand
Patent quality	Scope of patentability search	6.2.6	External or in-house researcher performed a comprehensive patentability search for this patent
	Prior art	6.3.3	Current invention is far from the prior art
	Citations (relevant for patent applications, only)	6.4.4	We don't expect any cited patent and/or non-patent literature references for this invention.
	Results of the examination phase (relevant for granted patents)	6.5.6	No citations
	Opposition during opposition stage (relevant for granted patents)	6.7.4	Opposition not expected
Infringement	Expected median cost of litigation	7.2.1	The patent has high projected litigation costs
	Proof of infringement	7.3.1	Third party infringement is difficult to prove
	Existing infringement	7.4.1	We are not aware of any third party infringement
	Tolerated infringement	7.6.1	There are no tolerated infringement cases
Existing usage	Existing license agreements	8.2.1	There are no license agreements.
Sustainability	Innovation cycles	9.1.1	Patent technology requires short innovation cycles
	Impact e.g. on other technologies	9.2.3	The patent significantly influences the development of other technologies
Legal influences	Existing policies that promote or regulate the invention	10.1.4	Existing policies have a positive impact
	Invention is based on legal principles	10.2.3	Laws favor the use of the described invention
Patent technology, technology environment	Technology integration and feasibility	11.1.3	Invention can be used in many application areas (basic)
	Technology scope / application of the invention	11.2.3	Description of a complete technology, product or system
	Technology contribution	11.3.4	The described function generates SIGNIFICANT advantages through the implementation of the described technology/process: ease of use, speed, quality, investment costs (e.g., reduction of existing costs).
	Technological relevance - "Is it fashionable?	11.4.3	High importance of relevant technology area
	Patent scope	11.5.4	Patent describes combination of product and process

Category	Characteristic	No.	Answering option
Portfolio	Patent history - innovation or evolution	12.1.2	The invention is a complete innovation
	Patent family member filings	12.3.2	Patent family member applications present
	Legal status of patent family members	12.4.2	Some equivalent patent applications are pending
	Foreign rights	12.5.2	The patent/invention contains features of a foreign patent in force, license agreement in force or available
Influence factor: sector of activity	Licensing revenue Average share per year	13.1.5	In this industry, the average revenue share is more than $100,000 per licensee.
	Level of innovation expected by target market (consumers)	13.2.3	Target group always demands innovation
	Level or intensity of competition (e.g., comparable number of market participants)	13.3.3	Moderate competitive activity
	Assessment of purchasing power (return on sales) in a particular industry	13.4.8	Average profit margin in this industry is between 25% and 40%.
Targeted market and market development	Barriers to entry	14.1.1	Closed Circle' -> High barrier to entry
	Level of investment barriers	14.2.1	High investment barrier
	Accessibility of the market	14.3.2	Market access is easy
	Potential average profit margin of the company for the given product	14.4.6	51-66%
	Monopoly value of exclusivity (1 licensee)	14.5.1	An exclusive license to a licensee would be important (licensee monopoly on technology)
	Market size (potential number of licensees)	14.6.4	Number of potential licensees is 11-20
	Potential market volume growth	14.7.3	Invention opens up a whole new market segment
	Possible uses (benefits), R&D efficiency improvement	14.8.2	Invention significantly improves quality
		14.8.3	Invention mainly affects time optimization processes
		14.8.4	Invention results in significant cost savings
	Allow or prevent	14.9.2	The invention enables only a specific sub-function.
		14.9.3	The invention only enables the manufacturing process of a specific main function or application.

Category	Characteristic	No.	Answering option
Targeted market and market development	Allow or prevent	14.9.4	The invention prevents certain (harmful and unintended) functions.
	Benefits to customers	14.10.2	Benefit of the technology is directly perceived by the user