

E-GPR 2006 Project description

DEVELOPMENT OF A NEW SMALL TRANSPORT DEVICE

By NIKO Company

Contents

1.	The project proposal	3
2.	Requirements	3
3.	Expectations of NIKO from EGPR 2006	6
4.	A short survey of existing solutions	7
4.1	Manual powered carts	7
4.1.1	Example 1: »RuXXac-cart« for transporting loads inside and outside of the buildings 7	
4.1.2	Example 2: Transport of flower pots inside the buildings	8
4.1.3	Example 3: Transport cart for inside and outside the buildings	9
4.1.4	Example 4: Transport cart for inside and outside of the buildings	10
4.1.5	Example 5: Delivery of intermediate goods or products	11
4.2	Battery-powered cart for transporting loads up and down the stairway	12
4.2.1	Example :Transporting loads up and down the stairway	12
4.2.2	Example 7: Transporting loads up and down the staircase	13
4.2.3	Example 8: Transporting loads up and down the staircase	14
4.2.4	Example 9: Transporting loads up and down the staircase or a truck.....	14
4.2.5	Example 10 Transporting loads up and down the stairway or a truck.....	15
4.2.6	Example 11: Transporting loads up and down the stairway or a truck.....	16
4.2.7	Example 12: Transporting loads up and down the stairway or a truck.....	17
4.3	Electric cart for transporting loads up and down the stairway – track-laying	18
4.3.1	Example 13: Transporting loads up and down the staircase.....	18
4.4	Cingo – miniature tracked carrier for outdoor works	19
4.4.1	Example 14: Transporting building materials and soil	20
5.	NIKO company	21

1. The project proposal

The NIKO company proposes to the academic virtual enterprise EGPR 2006 and its participants **to develop a new small transport device**. Based on a short survey of the existing solutions on the market, we have summarized the requirements in the current document. The basic characteristics should be as follows:

- a) it is intended to transport the loads in the range 50-300 kg
- b) it has to be operated by a single or at most two persons
- c) it should be able to climb up and down the staircases
- d) the distance to carry the load should be up to 300 m
- e) the device itself should fit into a personal car

The target users are the craftsmen and employees of small companies, who perform field work in living houses, perform smaller civil engineering works on buildings, cleaning services, furniture transport companies, etc. The product is intended for European and United states market and has to meet local law regulations.

The existing solutions on the market are relatively expensive. Due to their narrow scope of application, their use is rather limited. NIKO has consulted an expert from a civil engineering company, who said: »An engine driven transport device is not of an interest for a company which specializes in traditional heavy duty construction works. The idea is better suited to the craftsmen companies in the fields of finishing works, such as flooring, tiling, plumbing, electrical works,... A mixer that automatically loads some sand and cement to prepare the concrete sounds interesting. I have seen an example, however, the problem is its robustness as the workers' education level is rather low, and the work is very rough, which leads to frequent damages. We would buy the cart in case it justified the costs (retail price, maintenance, depreciation and reduction in the number of workers at the construction site).«

NIKO representatives visited some construction sites and monitored individual working processes. In the case of reconstruction of an old building it was observed that the transport of the material between the locations inside the building and the lift trunk was manual, using a wheel barrow.

2. Requirements

Many works involve a transport of some material or goods. Smaller loads of up to 100 kg can be moved around by small carts, which use workers' manual power. Small carts are mainly used by companies in the public utility sector, companies providing different services and companies involved in the finishing phases of a construction. **With the respect to the operator**, the requirements are the following:

- Manipulation with the device has to be easy.

- The device has to be ready to transport the load in a few seconds.
- The outlook of the device has to raise the feeling of confidence, that it is reliable and strong enough to carry even very heavy loads
- The outlook (the design) of the device has to be fancy, modern and acceptable for the majority of potential customers

The device has to have technical characteristics, that overcome the ones, which already exist on the market. Currently, there exist a number of carts for ground transport of loads (transport on flat surfaces and stairs) and lifting. They are usually man-powered. Some solutions use battery power or an internal combustion engine as a source of energy. Their load capacity is usually between 100 kg and a few thousand kilograms. A device's maneuvering characteristics are also important. Manual carts move on wheels while carts, using other sources of energy, may use caterpillar tracks and special mechanisms. Small hydraulic platforms are used in warehouses. Based on a short survey of existing solutions, the following lists **the technical requirements of the device** to be developed:

- The access to remote places: It is important to reach all places inside buildings, including basements and the attic. It is important that it is possible the cart to put together on such a small area, that you can drive in car boot (It should be folded).
- Small size and weight of the device: There are the limitations regarding the size of the device, which can be attributed to the ease of transport and access to the rooms through standard size doors. Therefore, the device should fit into a personal's car boot (it might be somehow foldable). Regarding the easy entry to the rooms within the building, the maximum width of the cart should not be more than 750 mm. The height of the device should not be more than 800 mm. The weight of a single piece of the cart should not exceed 12 kg. The use and manipulation of the device should not present any difficulties to a female.
- The size of the load is based on the standard EURO palette size. Many car manufacturers are aware of this standard. The boots for cargo in vans are designed according to this particular standard. Our goal is to design the device to carry the load of maximum dimensions height = 1200mm, width = 800mm and length = 1200 mm.
- The weight of the load: The target users usually use vans to move the goods around, whose load capacity is less than 1500 kg. However, the workers usually do not use the tools, whose single piece would exceed the load of 300 kg due to difficulties of loading it into the van. The maximum load expected is therefore 300 kg.
- The velocity of the transport: the velocity should be approximately the same as the velocity of a man walking (in the range 0,8 - 1,4 m/s).

The source of power: One of the crucial issues of the project is to find appropriate source of power to operate the device. It is also clear, that this issue also strongly influences the production costs of the device. Man power, the electrical motor with rechargeable batteries or external power chord, internal combustion engine, etc. are examples of many possible solutions.

- Additional functionality: To gain some advantage over potential competitors, the developers are encouraged to seek for additional functionalities of the device, which can be of some use to the customers. As an example, we list some ideas: a vacuum cleaner, a utility ladder mounted on device, toolbox storage, etc.

From **the economical point of view**, the requirements are as follows:

- The target market: The most important market for NIKO company is European market, where NIKO sales over 80% of its production. However, with some adaptation and different marketing strategies, other markets may be attacked. East European and Asian market, especially Near East, are potentially promising because of intense building industry.
- Target users: Small companies involved in final civil engineering phases, Craftsmen's works (craftsmen for parquetry, stove makers, house painters, carpenters, marbling, electricians, plumbers), furniture movers, cleaning services,... Users should be adults, male and female.
- Target quality and price: The product should be produced in different versions, which should be adapted to potential markets: a) for most demanding West European market, a technically sophisticated device should be developed with some additional functionality (transport and performing other tasks). We estimate, that the selling price of this version should not exceed 100 EUR (+TAX). b) For less demanding markets, probably man powered, with only basic functionality, the price should not exceed 40 EUR (+TAX).
- Target quantity: We expect, that in the first stage, 1500 – 3000 pieces per year can be manufactured within the facilities of NIKO company.

The universal transport working device would be of an interest to finishing works contractors as it would make the transport possible and some physically more demanding works would be easier. However, it is our opinion that it is not suitable at all for earlier phases of a construction process as there are still a lot of works that can be performed manually, especially with reconstruction.

3. Expectations of NIKO from EGPR 2006

NIKO company has been well acquainted with the history of the EGPR and with the results, which have been achieved by participants in the past years. Based on this information, NIKO tried to formulate the realistic expectations from the academic virtual enterprise as follows:

- The participants should perform an extensive research on existing solutions, providing information about properties, features, advantages and disadvantages, production prices and selling prices.
- The participants should formulate innovative solutions to the issues, which are described in the section “requirements”. The solution proposals have to be consistent and feasible.
- The proposals should be communicated to NIKO, which should participate in the proposal evaluation.
- NIKO will financially support building of the prototypes. However, only solutions, that have been agreed between Academic virtual enterprise and NIKO, will get further financial support.
- NIKO expects, that at least four functional prototypes will be built by the end of the course in June 2006, whose main function (the transport of the specified load up and down the staircase) is fulfilled.
- Other requirements ...

4. A short survey of existing solutions

4.1 Manual powered carts

4.1.1 Example 1: »RuXXac-cart« for transporting loads inside and outside of the buildings



Figure 1: Manual-powered cart

Properties:

Weight [kg]	Load capacity [kg]	Adaptivity	Material	Price [EUR]
5,2	100	When folded only 5.5 cm thick	aluminum, plastic	86 – 106

Features:

- Ready for use within 5 seconds
- Every load can be perfectly fixed on the trolley with the load - securing system
- Puncture safe tires
- It is not very suitable for transport up and down staircases

A lot of companies are producing similar carts. One of them is also in the China:

<http://www.qd-huatian.com/>

4.1.2 Example 2: Transport of flower pots inside the buildings

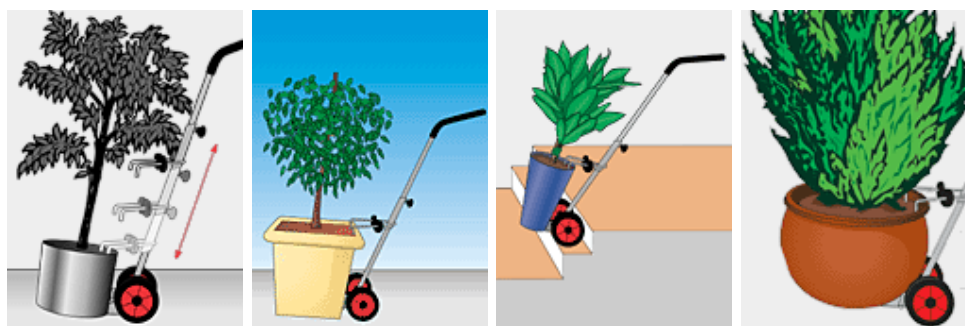


Figure 2: Manual-powered cart for flower pots

Properties:

Weight [kg]	Load capacity [kg]	Adaptively	Material	Price [EUR]
/	60	Yes	Stainless steel, plastic	39

Features:

- For all kinds of flower pots
- Safe footing because of support handle

4.1.3 Example 3: Transport cart for inside and outside the buildings



Figure 3: Manual-powered cart

Properties:

Weight [kg]	Load capacity [kg]	Adaptivity	Material	Price [EUR]
/	250	No	Stainless steel, steel tube plastic coated	

Features:

- With wheel protection as well as with safety hand grips as standard, foot plate thickness 4 mm
- Pneumatic tyres with cleat profile and tyre valve

4.1.4 Example 4: Transport cart for inside and outside of the buildings



Figure 4: Manual-powered cart – shop easier

Properties:

Weight [kg]	Load capacity [kg]	Adaptivity	Material	Price [EUR]
/	46	No	Stainless steel, steel tube plastic coated	

Features:

- With a folding design and removable bag, this versatile shopping cart has a multitude of uses.
- This shopping cart is available in 2-Wheel design and the Stair-Climber version, which features 3 wheels on each side for easy stair climbing.

4.1.5 Example 5: Delivery of intermediate goods or products



Figure 5: Manual carts

Features:

- Intended for transporting of smaller loads – delivery of intermediate goods and products.
- Man-powered, one person is usually enough. Some variants require two persons.
- A load standing on the ground can be put onto the cart by sliding without much effort.
- During the transport, the load's centre of gravity should be tilted into the position above the wheel axle, which relieves the operator of a lot of stress.

4.2 Battery-powered cart for transporting loads up and down the stairway

4.2.1 Example :Transporting loads up and down the stairway



Figure 6: Battery-powered stair-climbing cart with a special mechanism

Properties:

Weight [kg]	Load capacity [kg]	Adaptively	Material	Speed of moving	Price [EUR]
24	170	No	aluminium	29 stairs/min	2.397

Features:

- Intended for transporting smaller loads up and down the staircases.
- Allows transport on flat surfaces.
- The source of power comes is a battery with a capacity of 5 Ah, which allows climbing of 200-300 stairs per hour.
- Travel speed is approx. 29 stairs/min with a load of 170 kg or proportionally higher with a smaller load.

Description:

The load is placed onto the front part. On flat surfaces, the cart is used without the electric power. For climbing up and down the staircase, a special mechanical system is used (shown on Figure 6), driven by an electrical motor. <http://www.liftkardirect.co.uk/>

4.2.2 Example 7: Transporting loads up and down the staircase



Figure 7: Battery-powered stair-climbing cart with a special mechanism

Properties:

Weight [kg]	Load capacity [kg]	Adaptively	Material	Speed of moving	Price [EUR]
20	110	Partly	aluminium	48 stairs/min	2.397

Features:

- Intended for transporting smaller loads up and down the staircase.
- Allows transport on flat surfaces.
- The source of power is a battery with a capacity of 5 Ah which allows climbing of 200-300 stairs per hour.
- Maximum Step Height: 210 mm

Description:

The load is placed onto the front part. On flat surfaces, the cart is used without the electric power. For climbing the staircase, a special mechanical system is used (shown on Figure 7). It is driven by an electrical motor. <http://www.liftkardirect.co.uk/>

4.2.3 Example 8: Transporting loads up and down the staircase



Figure 8: Battery-powered stair-climbing cart with a special mechanism

Properties:

Weight [kg]	Load capacity [kg]	Adaptively	Material	Speed of moving	Price [EUR]
40,5	310	No	Steel tube	8 – 9 stairs/min	3630

Features:

- Maximum height of the load is 1100 mm
- Battery: 24 V 6.5 AH

4.2.4 Example 9: Transporting loads up and down the staircase or a truck

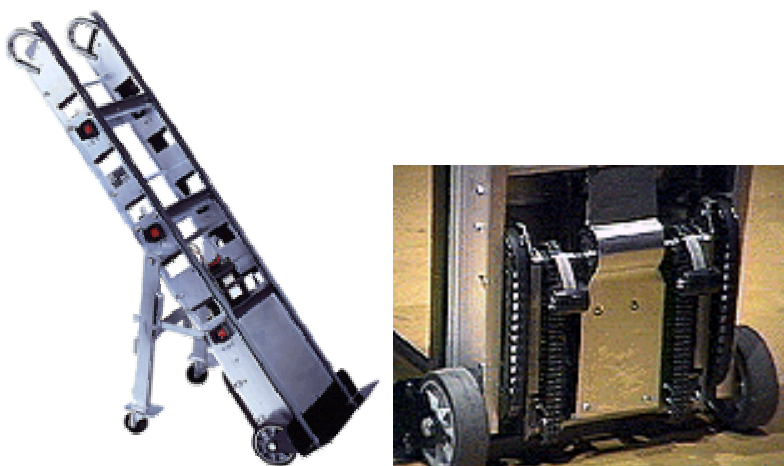


Figure 9: Battery-powered stair-climbing cart with a special mechanism

Properties:

Weight [kg]	Load capacity [kg]	Adaptively	Material	Speed of moving	Price [EUR]
/	320	No	Aluminium alloy	13 stairs/min	1268
/	547	No	Aluminium alloy		1437

Description:

Escalera Stair Climber stair climbing handtrucks are constructed of a tough tempered aluminium alloy, making the handtrucks stronger than magnesium, but lighter than steel. All Escalera Stair Climber handtrucks are 24 inches wide and range in size from 60 inches to 72 inches tall. Every Escalera Stair Climber ships with the sealed gel-cell battery, automatic battery charger, and one automatic rewind safety strap included www.escalera.com

4.2.5 Example 10 Transporting loads up and down the stairway or a truck

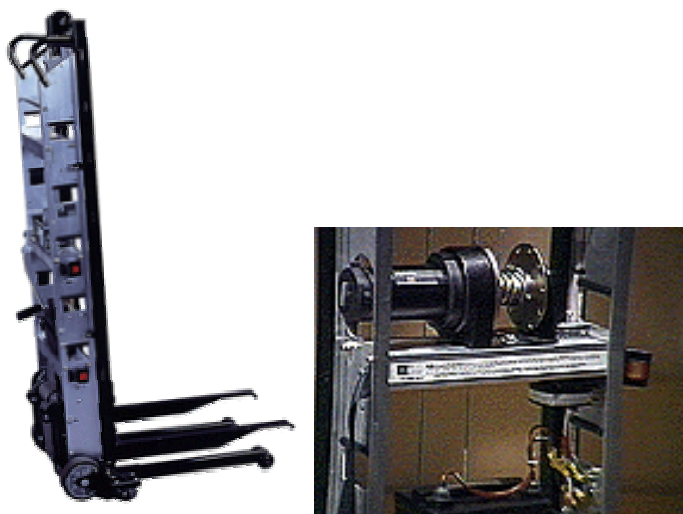


Figure 10: Battery-powered stair-climbing cart with a special mechanism

Properties:

Weight [kg]	Load capacity [kg]	Adaptively	Material	Speed of moving	Price [EUR]
/	547	No	Aluminium alloy		1690 1860 (with electric forklift)

Features:

- Forklifts are available with either a battery operated fork winch (EW), or a hand operated fork winch (HC).

- Escalera Stair Climbing Forklifts have side frames made from the same tough tempered aluminium alloy as the Escalera Stair Climber. In addition they have steel lift frames, with 28 inch long forks, for raising loads up to 54 inches - high enough to load or unload a semi truck!

4.2.6 Example 11: Transporting loads up and down the stairway or a truck



Figure 11: Battery-powered stair-climbing cart with a special mechanism

Properties:

Weight [kg]	Load capacity [kg]	Adaptively	Material	Speed of moving	Price [EUR]
/	297	No	Aluminium and steel	13 stairs/min	

Features:

- Fully Automatic Braking System
- Override Clutch
- Safety Grip Handle
- 100% Extruded Aluminum Construction
- Machine 24"W x 16½"D x 60" High
- Heavy Duty Control Switches
- Multi-Position Strapbar 24" Length
- Bar and Plate Felt - Protects Loads
- Heavy Duty Reinforced Straps 10 ft. Length
- Quick Release Safety Locking Cam

- Super Efficient Drive Screw
- ½ HP Orbital Gear Reduction Motor
- Completely Sealed Battery Box
- Sealed Battery 12V 20AMP Maintenance Free and Rechargeable
- Puncture Proof Wheels 8" Diameter
- Extruded Aluminium Toeplate 24"W
- Solid Steel Axle 5/8" Diameter
- Anti-Skid Protector On Heel Of Machine
- Lifting Height 40" (101.6 cm)

4.2.7 Example 12: Transporting loads up and down the stairway or a truck



Figure 12: Battery-powered stair-climbing cart with a special mechanism

Properties:

Weight [kg]	Load capacity [kg]	Adaptively	Material	Speed of moving	Price [EUR]
85	682	No	Aluminium and steel	13 stairs/min	

Features:

- Fully Automatic Braking System
- Override Clutch
- Drive Screw Top Guard

- Rugged Steel Outer Frame Carries Load
- Machine 27"W x 17"D x 68" High
- Heavy Duty Control Switches
- Two Heavy Duty Adjustable Strapbars 26" Length
- Bar and Plate Felt - Protects Loads
- Heavy Duty Reinforced Straps 14 ft. Length
- Quick Release Safety Locking Cam
- Super Efficient Drive Screw
- ¾ HP High Efficiency DC Motor Gear
- Retractable 2-Wheel Dolly
- Leverage Bar
- Sealed Battery 12V 28AMP
- Maintenance Free and Rechargeable
- Puncture Proof Wheels 8" Diameter
- Toeplate 27"W
- Anti-Skid Protector On Heel Of Machine
- Lifting Height 40" (101.6 cm)

Company: www.powermate.info

4.3 Electric cart for transporting loads up and down the stairway – track-laying

4.3.1 Example 13: Transporting loads up and down the staircase

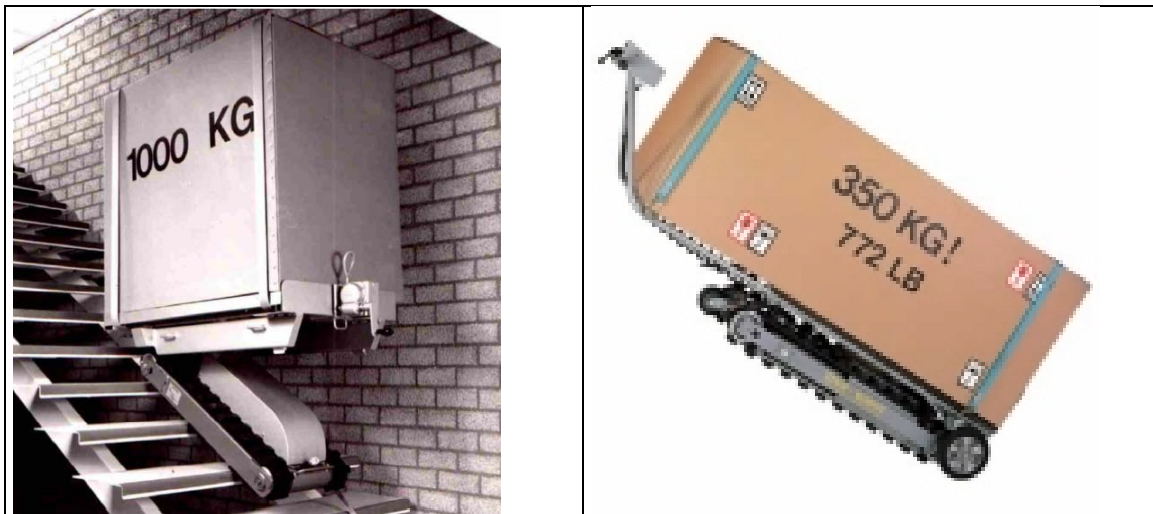


Figure 13: Battery-powered stair-climbing cart with a track-laying

Properties:

Weight [kg]	Load capacity [kg]	Folding	Material	Speed of moving	Price [EUR]
	1000	partly		3 m/min	11.585
	350	partly		4 m/min	5.847
	150	partly	Aluminium and steel	4 – 7.5 m/min	3.222

Description:

The load is placed onto the cart and moved to the stairs. With carts with a load capacity of 150 kg this is performed manually, while the versions with a higher capacity are battery-powered. For transport up and down the staircase, the cart lifts a load into the horizontal position. Transport is possible up as well as down the staircase.

Features:

- Intended for transporting loads up to 1000 kg up or down the stairway.
- Also allows transport on flat surfaces. Carts with the load capacity of 150 kg are man-powered on flat surfaces while others are battery-powered.
- Electric power comes from a battery with a load capacity of 1.5 Ah (load capacity 150 kg) or directly from the mains (load capacity 350 kg and 1000 kg)

Company: <http://www.stairrobot.com/>

4.4 Cingo – miniature tracked carrier for outdoor works

4.4.1 Example 14: Transporting building materials and soil



Figure 14: Miniature tracked carrier for outdoor works

Properties:

Weight [kg]	Load capacity [kg]	Folding	Material	Speed of moving	Price [EUR]
520	1000	No	Steel	300 m/min	
360	800	No	Steel	300 m/min	
340	600	No	Steel	300 m/min	5.000
200	400	No	Steel	300 m/min	

Description:

The Cingo cart is intended for minor construction and ground works outside the buildings due to the use of an internal combustion engine. It is handled by an operator who needs to be in constant touch with the cart.

Features:

- Intended for transporting smaller loads of building materials and soil
- An additional function is the transport of devices for minor construction works, such as a concrete mixer.
- It is driven hydraulically by a diesel engine
- Handling and movement: self-driven
- Annual production is 2000 pieces

Company: www.merlo.com

5. NIKO company

NIKO company is located in Železniki, which is about 40 km north-west from Ljubljana, capital of Slovenia. NIKO was established in 1946, when 15 Fifteen members of the cooperative society signed the constitution of the establishment of Metallurgic Cooperative NIKO in the belief that they would preserve more than a hundred years old tradition of ironworkers and nail makers, and that they would renew and consolidate the industrial activity. During the search for the appropriate products, an idea emerged to produce the utilities for paper document archiving. It was not important whether the idea was the consequence of the wish to employ blacksmiths, locksmiths and workers, or the deliberation about arranging documents of science, progress or culture. The visionaries at that time started transforming sheet metal and wire. The first products were the mechanisms to hold the stacks of papers, which were awkward and rough at first sight, but their functionality enabled systematic paper document archiving into organized files.

Today, almost 60 years later, NIKO companz is an open share-holding company with 288 employees.

NIKO production can be classified into 4 different programs:

1. the main program is a production of lever arch mechanisms for files, which include document binders, slidebars, and metal rods for hanging files and maps.

Using our own knowledge in developing technology and equipment, we automate our production more and more, and thereby we provide quick adjustment to the requirements of customers regarding the supply of various series and types of mechanisms (Figure 1). Our productivity is annually increased by 10%, and today nine automatic assembly machines manufacture more than 350.000 pieces of high-quality mechanisms, which results in the forwarding of two trucks with trailers per day. Our annual production exceeds 85 million pieces.

500 million of lever arch file mechanisms are used annually for archiving documentation in files all over the world, 400 million of them are used just in Europe. Switzerland is the leading country in using lever arch file mechanisms, where each resident needs on average 2 files per year; it is followed by Germany with 1.5 files per person per year. NIKO lever arch file mechanisms cover 21.5% of the needs on the European market, which means that our mechanisms are built in in every fifth file. Our tradition and quality have carried our mechanisms to more than 28 countries on three continents. In 2000 we became the leading European producer of lever arch file mechanisms in quantity as well as in quality.



Figure 1: Mechanism M75

2. the second program involves production of wire paper clips, drawing pins, office and industrial staples and pneumatic tools.
3. the third production program are metal fibers for reinforcing of concrete (Figure 2), which is targeted to the field of civil engineering . Metal fibres can replace the traditional net reinforcement and may successfully be used in a wide variety of applications and products such as industrial flooring, warehouses, factories, distribution centres, cold storage, tunneling etc.

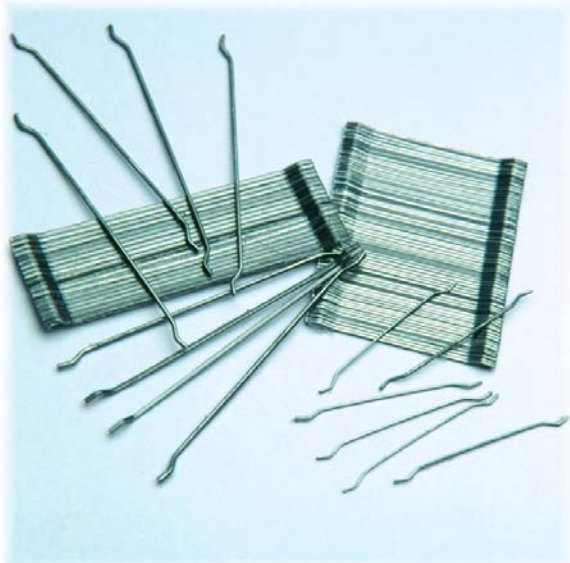


Figure 2: Metal fibres

4. Niko also maintains a tool shop where some special tools are manufactured, such as sheet cutting and steel reforming tools, plastic moulding tools and computer controlled assembly lines.

About 7% of products is sold on Slovenian market and 93% in other countries. Products of NIKO are present in 28 states on 3 continents, but the most important is European market, which presents about 80% of whole sale. The annual income of company is 20 million EURO and the annual level of growth is 12%.