

# FORMWORKER MASTER

## FROM COLOMBIA TO THE WORLD

SOFTWARE FOR THE INDUSTRIALIZED CONSTRUCTION SECTOR. Statistics of building activity in homes and buildings in Colombia and Latin America show a significant and steady increase in the use of industrialized building systems. These systems are based on the technique of making reinforced fluid concrete poured into molds formwork, which are armed based on the modular assembly of reusable metal formwork, and maintained cohesive to resist pressure from the concrete by the use of various accessories such as spacers, turnbuckles, clips, pins, alignment, trusses, struts, etc.

The concrete casting process has two modes: in stages, or monolithic. In the stepwise method, widely used in Europe and some in North America, first place the formwork for walls and performs the initial walls pouring, once the concrete has set, remove these formwork and proceeds to place the forms from slab and then make the final casting of slabs. In monolithic form, widely used in Latin America and some in North America, once placed in the formwork of both walls and slabs, adding those few special formwork which function to keep joined these two parts, and then performs a single drain to melt while the walls and slabs at same time.

This system has gained great popularity due to major advantages: it is efficient to allow the construction of one floor per day, allows great savings of up to 40% on labor costs, facilitates inventory control and work minimizing waste, provides an excellent finish, is environmentally friendly by not using wood, the cast monolithic structure ensures resistant to earthquakes, has ease of handling and storage, is reusable up to 1,500 times, the modularity allows different uses on projects, and is adaptable to the particular requirements of each project builder.

The boom in the use of this system in industrialized building has given way to the birth of a group of companies located in the engineering sector, dedicated to making both the formwork, whether in aluminum or steel, as accessories. These companies not only cover the domestic market but have been designed with great force to penetrate international markets, particularly to Latin America, becoming major exporters of this building technology.

Based on this background of continued growth and leadership of our formworkers businesses, and based on our expertise and knowledge in the field of computer graphics and artificial intelligence, proceeds to perform an exhaustive evaluation of existing software packages in Europe and North America and computer tools used by this sector in our country and Latin America.

Outside Europe and North America, found some packages of excellent software, all providing an automatic modulation (calculation and placement of formwork), being the main feature that defines the technology in this sector. Nevertheless it presents very specific features that make its use in our midst:

1. Only allow working with forms from specific brands.
2. None includes special formwork connecting walls with slabs to drain mode monolithic.
3. The accessories used are different.

In our country we find that there is no commercial software package, each formworker has developed its own tools, using generic Computer Aided Design (CAD) packages, but none has



succeeded in producing an automatic process of modulation. They have only reached to develop manual modulation processes, which makes them uncompetitive in several ways:

1. The modulator must be an expert in the use of CAD tools.
2. The calculation of reusable parts within the same project, or compared to other projects already built, is done manually.
3. La Modulation of a project takes a long time. A simple house on one level requires a minimum of 40 hours, while a simple building with three different plants require more than 160 hours.
4. Undeliverable quotation with modulation included.
5. The quotations are inaccurate in their numbers, so let's use a very high error margins.

Based on this situation was clearly detected the existence of a deeply felt need formworker sector, and it was decided to develop a cutting-edge technological tool to fill this gap. Thus was born the FORMWORKER MASTER software.

## ADVANTAGES

The overall objective of the development project is to provide the formworker industry with advanced computational tool based on technology that supports these companies be more competitive in the global market. Initially we hope to cover the Colombian market, and increasingly rely on international markets to be taking: first oriented to Latin America, followed by North America and Europe if possible, without discounting the possibility of coming to Africa and Asia.

The specific objectives pursued with the tool to be developed include: it is automatic modulation, which supports the two types of concrete placement, handle different brands of formwork, allowing quotation with modulation included, which is autonomous in terms of tool CAD, it is easy to use, to convert the complex processes in simple settings, it is faster to produce results, to be precise calculations, which is flexible in its configuration, and produce economy in the processes covered.

**Automatic modulation.** This is the most important goal to achieve, since not having it is the greatest weakness found in local development, as it is constituted as standard external packages.

**Pouring modes.** We intend to cover the two modalities, in particular we want to target mode monolithic concrete pour, and that is not covered by any existing packages.

**Different brands of formwork.** Our tool should be able to adapt to different industrial building systems used by any formworker, including formwork and accessories. There are large metal formwork usually aluminum and steel formwork generally small, and practically every formworker uses a set of different accessories.

**Quote with modulation.** Seek to change the habits of our formworker industry, fulfilling one of its deepest aspirations. This is only possible if it is supported by an automated process of modulation.

**CAD tool independence.** The software must include a CAD tool, compatible with many existing CAD packages and makes it independent of them.

**Reuse of parts.** It will include how to calculate the parts can be reused by the method of inventory compared to other construction projects.

**Ease of use.** The product should be operated by any person, not specialized in the use of CAD tools with minimal training in drawing.

**Process simplicity.** The modulation process, which is the most complex of this software should be as simple as possible.

**Quick results.** The results should be obtained as quickly as possible to make a significant impact in the process of trading.

**Accuracy in calculations.** The figures used in the quotation, should represent as accurately as the modulation of formwork and accessories calculation, in order to eliminate any margin of error.

**Flexibility in configuration.** The system must be easily adaptable to new construction systems, or variations within them, by identifying a universe of parameters stored and modified.

**Economy processes.** The use of this tool should impact the economic factor of all the processes involved: minimize the costs of developing quotes, minimize losses by inaccurate quotes and prices to maximize profits by more timely and better presented.



## FUNCTIONALITIES

The system consists of the following modules: Processes, Reports, Parameters, and Management.

### Processes Module

In this module the main focus of the system calculation functions, and is end user oriented software. It includes the following submodules: Directory, Modulation, Prices, and Monitoring.

**DIRECTORY.** Manages formworkers customer information, usually builders, and each of the contacts associated with each customer. Its functionality allows for updating the client directory.

**MODULATION.** Manages the information of construction projects associated with each customer. For each project manages modulated architectural plans, and collections of counts of parts removed from each plane. Its functionality allows: the update of the projects, import and export of CAD formats, editing of CAD architectural drawing, the automatic modulation of formwork, and direct extraction of parts counting schemes.

The module provides a basic CAD tool in which: the user draws the axes of the walls and slabs areas, associating the properties that characterize them, then the system automatically generates 3D modulation of different types of formwork required, and then you can manually remove or add new items, and finally to organize the presentation of graphical results.

The module also allows the extraction, from the architectural level modulated, the counts of different types and sizes of formwork, which are the basis for trading.

**QUOTE.** Manages the information of the quotations associated with each client, where each quote can be made up of several collections of counts. In turn each of these collections is composed of a set of items, each of which are managed: the possible reuse of parts, and the explosion of raw materials and accessories required for manufacture or assembly. Its functionality allows: the updating of the quotations, the definition of the collections include: the explosion of raw materials and accessories for each item, the calculation of reusable parts, compared to other projects or collections for the same price, and recovery the items quoted by the terms of dimensions of the item or commodity.

**TRACKING.** Manages the information of cases identified for each client and project, and related events that have occurred. Its functionality allows you to update cases and events, facilitating the monitoring of the processes of pre-and after-sales related to customers and their projects, according to the standards of traceability required by ISO quality certification.

### Reports Module

This module provides all users with the results of running queries and reports based on different data. These queries can be included or modified in the management module, allowing the definition of dynamic parameters.

It includes questions about: Quote, shopping list, cutting list, reusable, customers and contacts, projects, cases and follow-up events, parameters, etc.

### Parameters Module

This module is aimed at advanced users and allows the maintenance of the general parameters of the system, which facilitates the adaptation of the system to user needs, and which include: raw materials, finished products and its basic composition, modulation control variables and explosion, countries and cities, and inquiries and reports.

### Management Module

This module is aimed at advanced users and can perform the following administrative tasks: starting the database, import or export of parameters, and definition of queries and users of the system.

## MODULATION

The modulation allows to know exactly how many formwork, types and sizes that are required for a construction project, as well as they should be assembled. The modulation process is the most important feature of this tool as a way to do it automatically makes it a robot, which requires only two steps to solve the problem.

### First phase

The initial phase is mainly responsible for the modulation of the walls and slab-wall connections (monolithic). It should begin with the architectural plans provided by the manufacturer, and at first you must draw the lines of the walls. The lengths of the axes must coincide with the actual lengths in the project, in order that the modulation is real. The types of objects (Fig 1) managed by the system are: wall, door, window, and edge of slab.

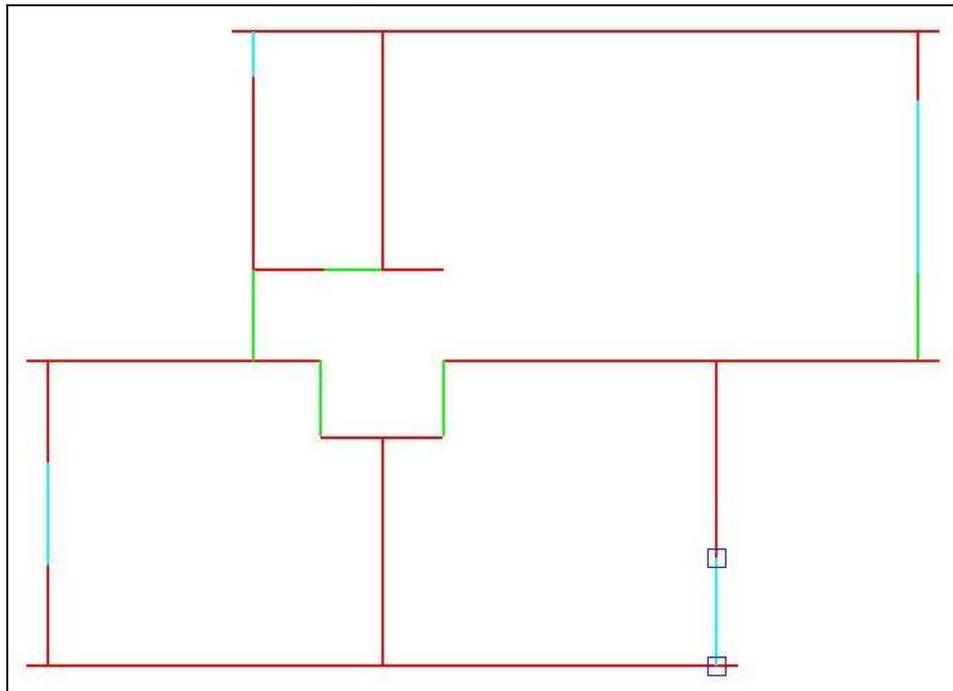


Fig. 1. Basic graph axes: walls (red), doors (green), windows (light blue), and slab edges (yellow).

Each of the two sides of an axis will be associated properties (Fig. 2) that characterize the type referenced.

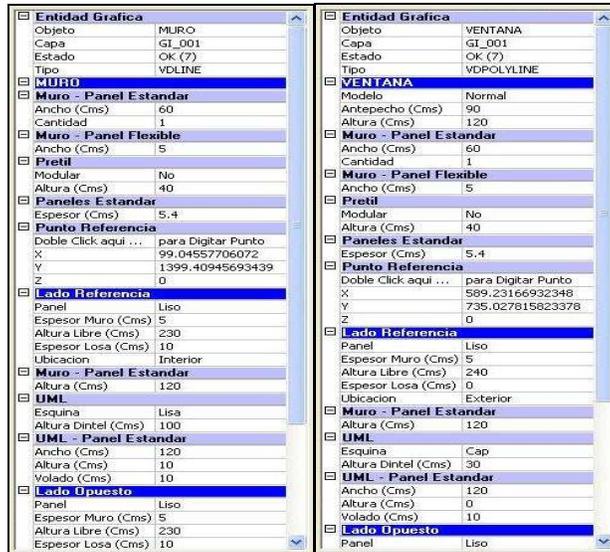


Fig. 2. Properties Example: walls and windows. These parameters associated with the axes of walls are the only input to modulate.

Based on the above information is ordered to perform the modulation system of walls, automatically generating (Fig 3) five types of formwork: walls, tops of doorways and windows, wall alignment, external scaffolding, and unions wall with slab. This modulation is stored in the CAD file into different layers for easy handling.

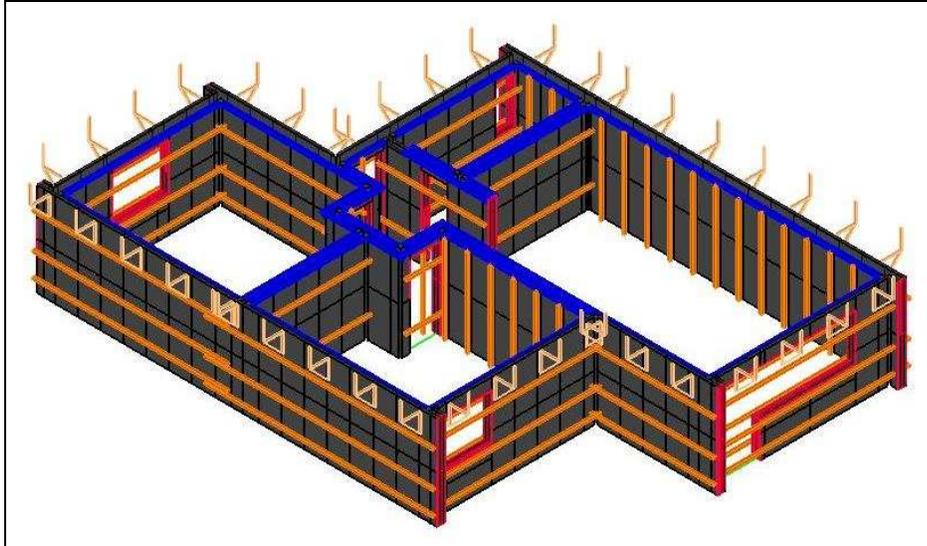


Fig. 3. Results of the Phase Modulation of wall formwork (gray), tops of doors and windows (red), aligner (orange), scaffolding (terracotta), joints of walls with slab (blue).

**Second phase**

The final phase is mainly responsible for the modulation of the slabs. For this phase modulation is to draw the areas of slabs, placed exactly in the framework left by the formwork of the wall and ceiling joints. Slab areas are represented by rectangles, and the types of objects (Fig. 4) managed by the system are: slab (purple), beam or truss and strut (blue), and fit (cyan).

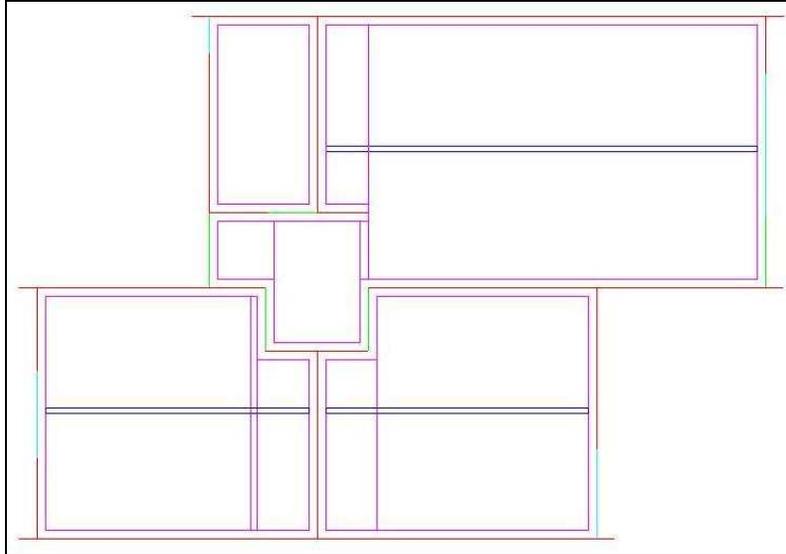


Fig. 4. Slab areas Graph, together with the axes of walls. This all the information input to the process of modulation. The objects are: slabs (purple), beams or trusses and braces (blue), and fittings (blue).

Each of the rectangles you must associate the properties that characterize the type referenced.

Based on the above information tells the system to perform the modulation of slabs (Fig. 5), automatically generating three types of formwork, slabs, beams (trusses) and braces, and fittings. This modulation is stored in the CAD file into different layers for easy handling.

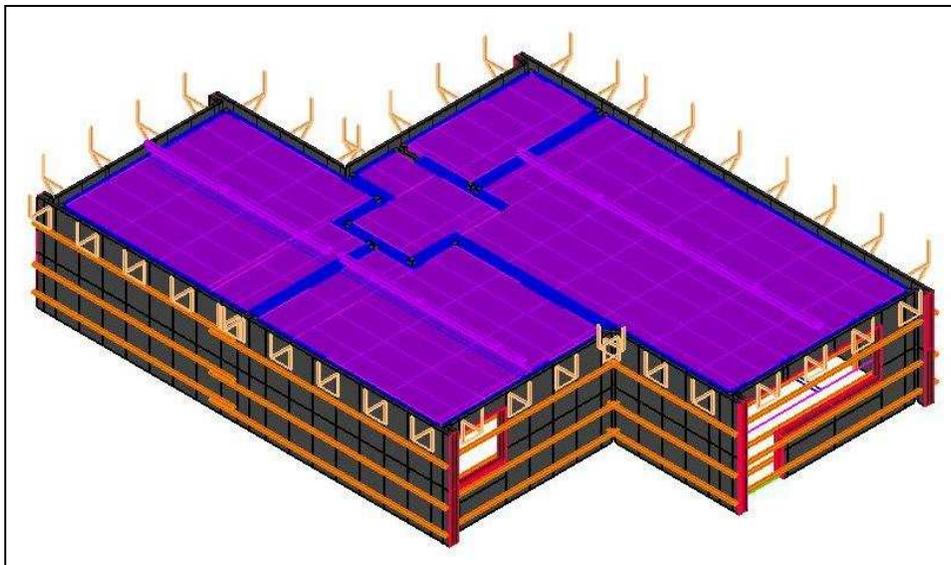


Fig. 5. Results of the modulation second phase, together with the results of the first phase. The objects are: slabs (purple), beams or trusses and struts (purple), and couplings (purple).

## MODULACIÓN REPRESENTACIÓN

This Graphic representations appear in paper space layout to be printed on plotters, as all standard CAD tool. The system offers several options for paper size and number of viewers, and easy editing of these viewers.

There is also the possibility of camera view, with real perspective projection, which can be manipulated with ease, taking control, camera placement, camera height, horizontal rotation of 360 degrees and tilt up and down (Fig 6). With one click on any of the modulated parts, the system displays the characteristic properties of the object.

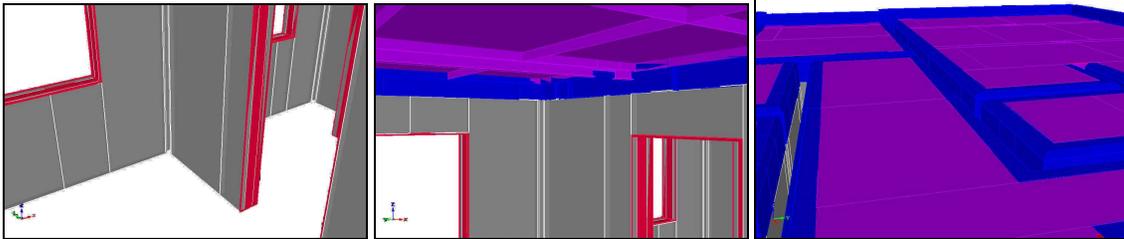


Fig 6. Perspective views of navigation within the project.

## QUOTATION REPRESENTACIÓN

The system automatically extracts of modulated plane, the counts that are the basis for listing. These items automatically on the explosion of raw materials and accessories, valued, and has the quote in report form (Fig 7).

Cotización Detallada en Pesos Col						
Cliente: IM CHELE S.A. Proyecto: Al Compuetro Versión: Computero 2 Ciudad: PROVIDENCIA-SANTIAGO País: CHILE Teléfono: 41233331 x1						
Lista de Precios de Venta						
Item	Cant.	Descripción	Unidad	Valor Unit.	Valor Total	
1	4	Agujero	m	4.5719	18.2876	83.25507
2	1	Angulo	m	4.0000	4.0000	35.00000
3	8	Barra de Aluminio 10	m	5.0000	40.0000	162.03379
4	20	Barra de Aluminio 12 Tapa	m	5.8375	116.7500	117.48936
5	80	Formalita Muro 1P	m	18.0071	1440.5680	999.03538
6	4	Formalita Muro 1P	m	120.2599	481.0396	217.019349
7	8	Formalita Muro 1P	m	113.6429	909.1463	5.905.82524
8	4	Formalita Muro 1P	m	165.1018	660.4072	5.843.810.00
9	8	Formalita Muro 1P	m	178.2283	1425.8264	597.187.48
10	2	Formalita Muro 1P	m	174.1017	348.2034	739.050.18
11	6	Formalita Muro 1P	m	155.5077	933.0462	470.188.54
12	6	Formalita Muro 1P	m	90.3481	542.0886	345.848.18
13	4	Formalita Muro 1P	m	151.4919	605.9676	454.284.69
14	10	Formalita Muro 1P	m	147.0002	1470.0020	590.149.34
15	4	Formalita Muro 1P	m	149.4019	597.6076	593.818.84
16	20	Formalita Muro 1P	m	118.1127	2362.2540	450.818.54
17	1	Formalita Muro 1P	m	71.7216	71.7216	700.026.40
18	4	Formalita Muro 1P	m	51.1460	204.5840	208.960.50
19	2	Formalita Muro 1P	m	114.0214	228.0428	302.81.211
20	2	Formalita Muro 1P	m	54.0014	108.0028	189.059.30
21	20	Formalita Muro 1P	m	110.8448	2216.8960	364.055.21
22	2	Formalita Muro 1P	m	55.3807	110.7614	70.521.31
23	2	Formalita Muro 1P	m	55.0942	110.1884	171.824.40
24	2	Formalita Muro 1P	m	108.4464	216.8928	318.897.40
25	2	Formalita Muro 1P	m	104.1181	208.2362	302.669.32
26	2	Formalita Muro 1P	m	101.4630	202.9260	303.336.71
27	1	Formalita Muro 1P	m	12.0070	12.0070	465.611.81
28	2	Tapa	m	21.2214	42.4428	384.960.84
29	1	Tapa	m	13.4844	13.4844	318.330.00
30	2	Tapa	m	84.1449	168.2898	145.441.38
31	11	Tapa	m	7.4072	81.4792	110.409.38
32	12	Tapa	m	4.2441	50.9292	55.909.16
33	6	Tapa	m	4.1128	24.6768	74.763.86
34	2	Tapa	m	3.8071	7.6142	48.440.50
35	4	Tapa	m	3.7064	14.8256	69.317.27
36	3	Tapa	m	3.5469	10.6407	63.666.00
37	1	Tapa	m	2.5000	2.5000	10.815.12
38	1	Tapa	m	2.5000	2.5000	46.004.19
39	1	Tapa	m	2.0701	2.0701	17.371.10
40	1	Tapa	m	2.0201	2.0201	36.460.38
<b>Total Muro</b>						
				88.23		
<b>Total Muro</b>				382.79		
<b>Total Formales para Muro</b>						
				32.273.0091	555.842.58	146.521.512.53
Item	Cant.	Descripción	Materia	Valor Unit.	Valor Total	
054.C	1	CUBETA 300x300x45	Acero 1000mm x Trazado 45	0.0000	850.0000	1.250.00
2359	1	CUBETA PARADIC	Acero Trazado 300	0.0739	189.110	487.50
1647	1	PARADIC CUBETA	Acero Trazado 300	0.1100	182.570	1.560.00
912	1	PARADIC FLECHA	Acero Trazado 300	0.2999	278.588	6.250.00
312	1	FEB UBRADA	Acero 1000mm x Trazado 45	1.0000	312.0000	375.00
<b>Total Accesorio para Muro</b>						
				1.814.4819	312.182.257.50	

Fig 7. Reporting model for the quote.

## CONSIDERATIONS

- Roster Software, a Colombian company specialized in intelligent computer graphics, has developed FWM Software, the most modern and powerful tool to support the formwork manufacturing industry (Formwork, Panels, Molds, Shields), and Builders their customers.
- The FWM Software has won the INFORMATIC'S COLOMBIAN PRIZE 2009, awarded by the Colombian Association of Systems Engineers ACIS. This is the highest award given in Colombia to the work of major scientific and technical merit in the area of informatics, certified as a quality solution and technological innovations.
- The metal formwork manufacturing industry can add value to their products, accompanying them with the latest computer design technology, FWM Software.
- As manufacturers and owners of FWM Software we offer our services to metal formwork manufacturers, a software adapted to the characteristics of the form of modulation, explosion of raw materials and accessories calculating that characterize each formworker in particular.
- The constructors, formworker clients, have a free version RosterCAD design module, with which they can in an autonomous manner, making the design of the axes of walls and slabs areas of their projects with their respective allocation properties, design that will be sent to the formworker to respective modulation is carried out, and check the results received from formworker modulation. Modulation can only run in the FWM of the Formaletera Software, which is protected by physical security keys.



INFORMATIC'S COLOMBIAN PRIZE (SYSTEMS ENGINEERS COLOMBIAN ASSOCIATION)

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