iKvant+ is the extended version of automated information processing and control system **iKvant**, which includes a set of additional software modules and is designed to organize even more detailed management and maintenance of the production process.

It allows to automate the management and control of the technological process at level of material movement over working area, workers individual performance and personal plan and logistics support for raw material supply and finished goods shipments of the factory. This is designed for usage at medium-sized enterprises of the light and food industries.

General structure

Production system in its advanced version providing extended solution for such important factors of production workflow as workers productivity and material movement through warehouse for all grades in dedicated cages.

For workers there will be automatically provided information about personal plan to achieve for the shift and practically handled amount of material. System is handling data and actual performed plan for workers productivity collected at all production working places and individual working positions.

For collection of trolleys with materials movement status there supported scanning of trolleys with integrated barcode or RFID tag at each working place and single working position. There could be also a dedicated position of trolleys loading and unloading at chosen areas of warehouse.
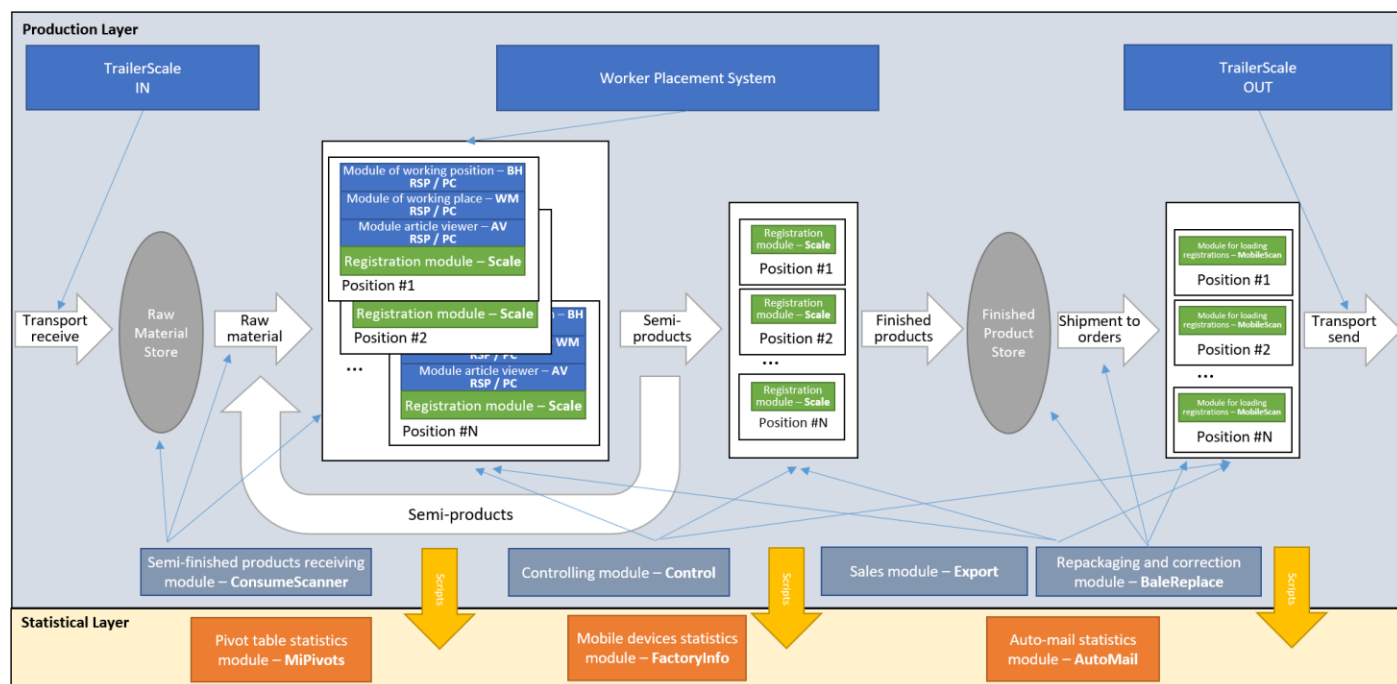
These actions support allows to count handled amount of goods at working positions at each moment of time, compare it to actual time moment taken shift plan, evaluate individual worker's performance, to observe location of trolleys and availability of needed raw material at working position's input.
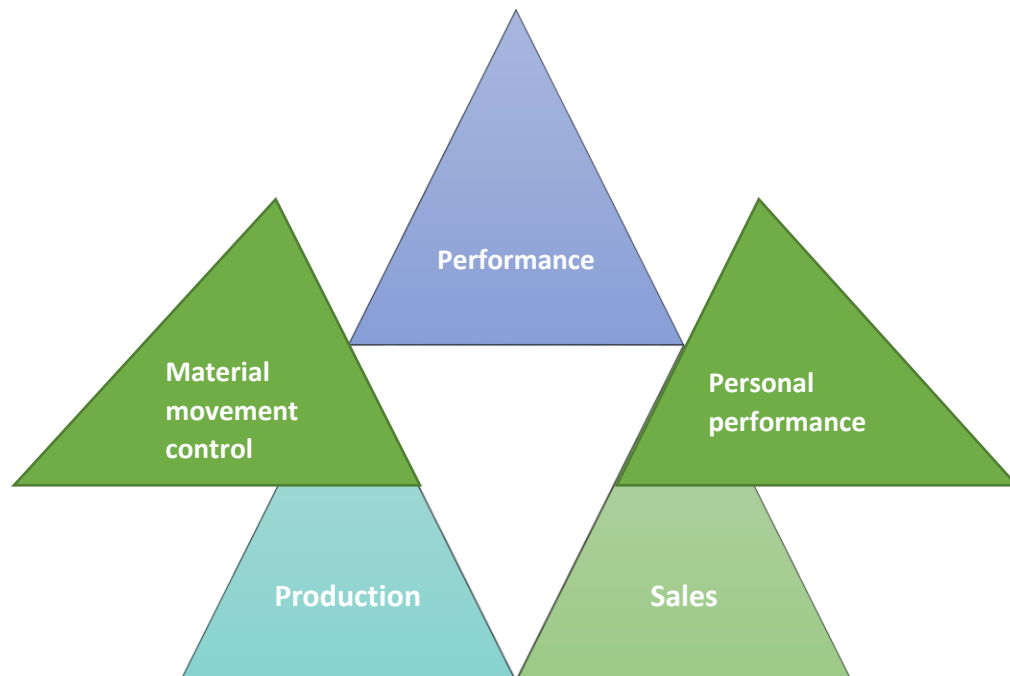
All these steps are supported with additional automation modules, which could be integrated in chosen subsets to individual positions in selected set or for all positions of the factory.

It's needed to put attention to special point of presented economical advantage of used technology in this implementation due to wide usage of Raspberry platform computers as head carrier of individual working positions automation. This effective solution allows to reduce expenses significantly and still keep all needed performance with getting even higher stability and secure run of factory position automation dedicated to operate on single task, which uses resources most effectively.

Below is a principal scheme for workflow structure with included advanced modules of **iKvant+**

Production Layer

TrailerScale IN

Worker Placement System

TrailerScale OUT

Module of working position – **BH** RSP / PC
Module of working place – **WM** RSP / PC
Module article viewer – **AV** RSP / PC
Registration module – **Scale**
Position #1

Registration module – **Scale**
Position #2
...
Module article viewer – **AV** RSP / PC
Registration module – **Scale**
Position #N

Registration module – **Scale**
Position #1

Registration module – **Scale**
Position #2
...
Registration module – **Scale**
Position #N

Module for loading registrations – **MobileScan**
Position #1

Module for loading registrations – **MobileScan**
Position #2
...
Module for loading registrations – **MobileScan**
Position #N

Transport receive

Raw Material Store

Raw material

Semi-products

Finished products

Finished Product Store

Shipment to orders

Transport send

Semi-products

Semi-finished products receiving module – **ConsumeScanner**

Controlling module – **Control**

Sales module – **Export**

Repackaging and correction module – **BaleReplace**

Scripts

Scripts

Scripts

Statistical Layer

Pivot table statistics module – **MiPivots**

Mobile devices statistics module – **FactoryInfo**

Auto-mail statistics module – **AutoMail**

Kvant

Working place monitor module – WM RSP

WM RSP module allows to display and register teamwork of a number of working positions combined together at single working place. This module performs displaying of actual performed and planned parameters in each current time moment. This information is displayed for single working positions values level and also summed level of whole team working at the working place.

This solution allows to operate composite teams and show at every working place, which containing a number of working positions summary values of all positions together joined in single team work and compare it to actual plan of whole team. Module will perform regular automatic update of sum values of handled amount of the material for the team and single working positions.
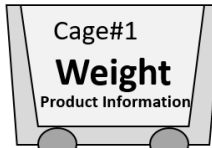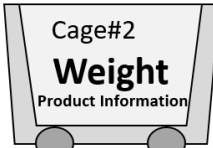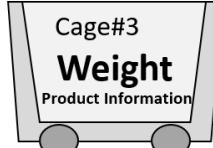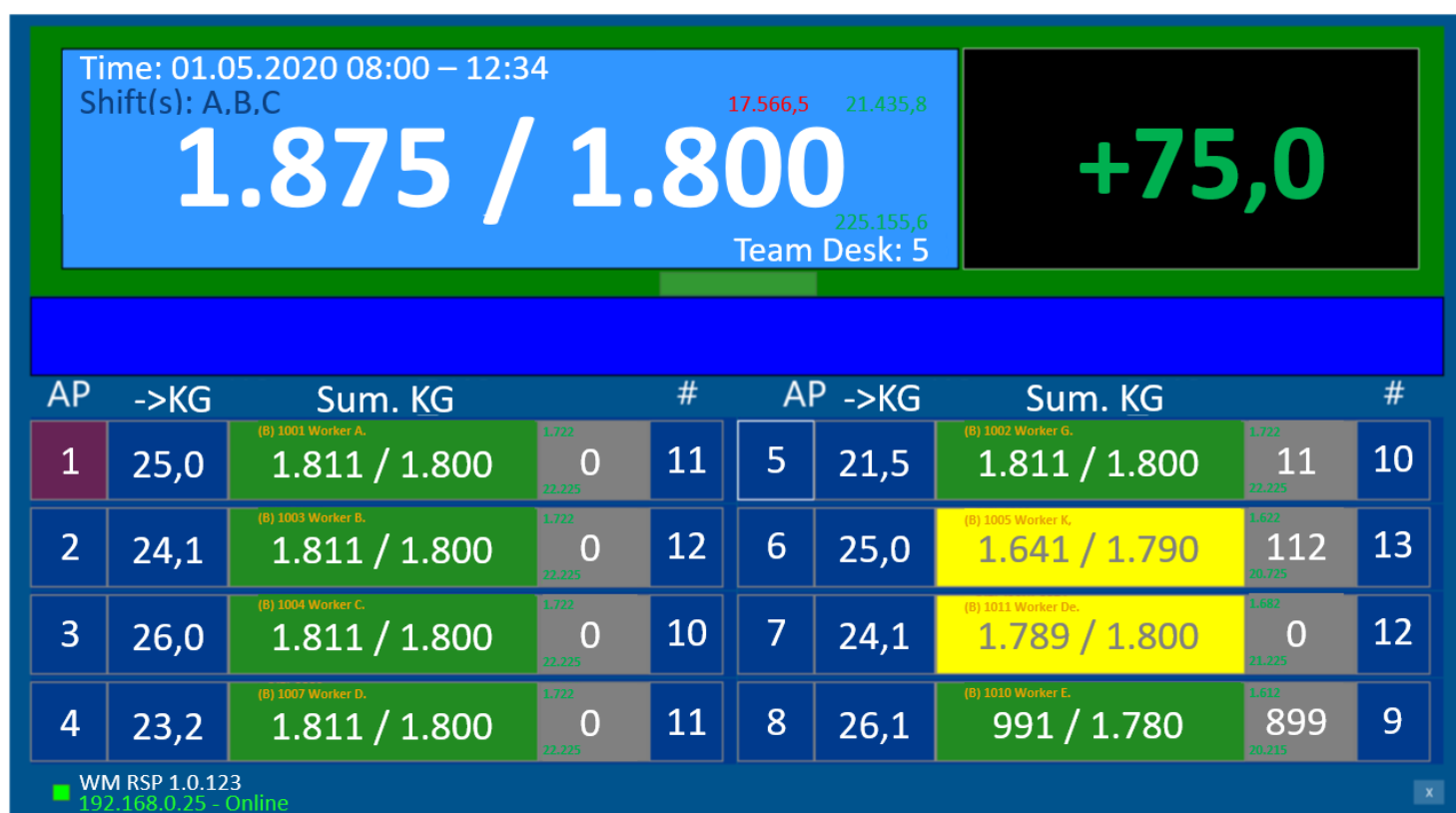

WM RSP working sample

Monitor module of single working position – BH RSP

BH RSP module allows to display and register work of single working positions. This module performs displaying of actual handled weight at current moment of time in real time mode, and compare it to planned weight at current moment of time. There will be easy recognized colored indication for status of working positions, which includes inactive status when no worker registered, active status with successfully performed plan till current moment (that will be displayed with green color gamma) and not achieved plan value, which will be displayed by yellow color gamma.

BH RSP module has an advanced detailed panel in lower half of the screen, which is displaying trolleys flow through this working position. This allows to see details about passing trolleys, which includes its carried product type, weight and other information. Passing of trolleys is registered in real time by worker actions at this position and operated by scanned barcodes or RFID tags reading.

As additional functionality the module allows to register and unregister workers at the working position in self-register mode with their individual ID cards, same way operated by scanned barcodes or RFID tags reading. This becomes visible automatically in central database of whole production system and allows to update manager's display about precise moment of particular worker was placed into the position. Also this allows centrally update workers allocation information to factory working positions, workers occupation status buffers and individual worker's performance parameters according to types of performed articles and specific of occupied working positions.
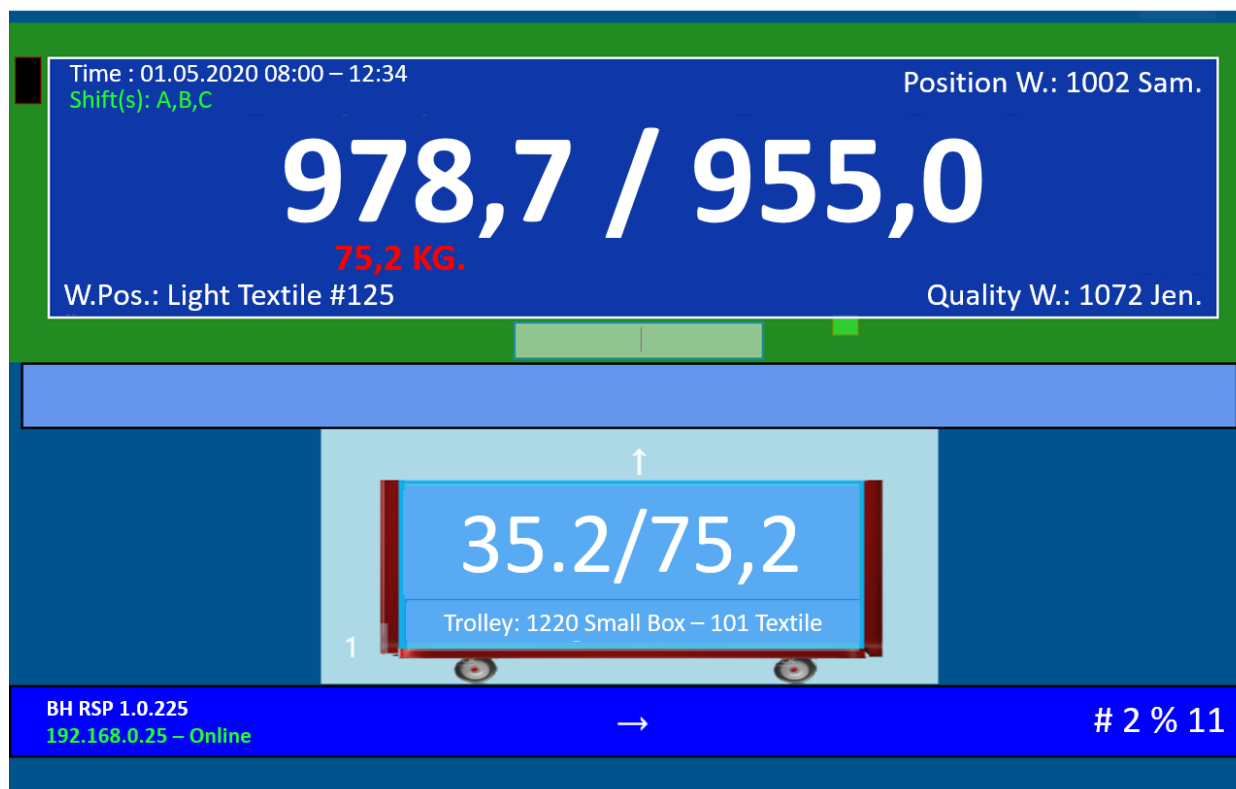
Module is able to actively use industrial devices connections for handling of input and output at working positions equipped with industrial automation. In sample of such functionality could be input from measuring or event sensors (such as weighing terminals, processing transport belts and so on) and command or status input/output devices (such as hardware switches, indication lamps and so on).

Working Shift Information		Active Worker Information
Handled Weight / Planned Weight **Weight of Cage in Progress**		
Working Position Information		Control Worker Information

Status Information Messages					
Position Type*	**Position Type***	**Position Type***		**Position Type***	
Cage#1 **Weight** **Product Information** Position #1	Empty Position #2	Cage#2 **Weight** **Product Information** Position #3	• • •	Cage#3 **Weight** **Product Information** Position #N	

Buffer Flow Direction**

Position Type* is optional from **Load Position, Unload Position, Wait Position**

Buffer Flow Direction* is optional from **Left-To-Right, Right-To-Left**

BH RSP module scheme

Time : 01.05.2020 08:00 – 12:34
Shift(s): A,B,C

Position W.: 1002 Sam.

978,7 / 955,0
75,2 KG.

W.Pos.: Light Textile #125

Quality W.: 1072 Jen.

35.2/75,2
Trolley: 1220 Small Box – 101 Textile

BH RSP 1.0.225
192.168.0.25 – Online

→

2 % 11

BH RSP working sample

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Module article viewer – APL RSP

APL RSP module serving to display actual information about articles production plan and targets. That is displayed according to its priority automatically updated by the system. This module showing currently required articles according to order list and availability of finished goods in the stock to complete orders. This allows to inform workers at working positions about needed articles, packings and weight amount targets to produce. List of target articles shown in this module is constantly updated to stay actual in connection centrally synced information in production system, usage of finished goods stock and newly produced finished goods at working positions.

APL RSP module performs completely automatic mode and makes itself according to configured quantity and interval updating of pages for top needed article positions.

Art.No.	ToDo	Weight	Article Name		Art.No.	ToDo	Weight	Article Name
10002	5	75.0	Article Textile #123					
10003	11	15.0	Article Textile #101					
20012	21	25.0	Article Medium #2					
20001	0	50.0	Article Medium #3					
30001	0	50.0	Article Low #1					

APL RSP 1.2.25
192.168.0.25 – Online

APL ID: 1001
APL Name: Monitor #21

14
Page 4 of 4

APL RSP working sample

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Worker Placement Module – WP

WP module is one of essential parts of production system. It provides shift managers with tools to register, browse and control a lot of parameters in area of personal management and personal performance during all shifts and at all categories, working places and working positions used in production process. **WP** module is manages workers allocation at their particular places, with exact timing of every single worker placement at workplace.

All actions are available for shift manager by drag-and-drop with real-time registration of placement during current running shift. In similar way is managed movement and presence of separate workers in logical buffers:

- Free (un-occupied) workers;
- Vacation workers;
- Absence due to illness workers;
- Long-term absent workers;
- Custom buffer.

WP module shows information orientated by dates, with feature to choose date and browse to future and past dates with filled data. According to current time, shifts are shown as active or inactive and in this way features of the system are working in different ways.

WP module have special administrative mode, which is able to be activated by request of special rights users. In this mode, system allows to adjust all workplaces parameters and attributes of workplaces groups as names, linking to production group, sub-group, planned performance for the shift on current shift, groups and sub-groups and many other.

WP module allows to make different rights access for different user accounts, which could be independent, system-internal with login and password or other case also active directory accounts of carrier server could be used. All accounts are able to get access or be denied of access for:

- Administrative mode;
- Chosen categories;
- Selected shifts;
- Other key features.

Additional feature of **WP** module is support of disruption layers at all working positions of all shifts and categories. This sub-system allows to manage disruptions also by using available disruption options pool and drag-and-drop technique to assign it for up to three ones at a time to single workplace. As result, **WP** allows to register exact time spent with particular disruption at every single workplace and use it in calculations of planned performance automatically.

WP module is making automated summary register and displaying amount of worker-hours spent during shift per separate workplaces and also at summary of every group nearby to its caption. There are features of compound clearance of existing data registration for chosen shift and paired copy-paste feature of data to current shift from last active previous shift. Copy-paste functionality allows to re-use data of workplaces workers, disruptions and other daily-changed information.

Worker Placement Control (3.0.128) Shift = A

Date	Shift	Category	Disruption	Worker Placement	Long Abs.	Abs. Illness	Abs. Vacation	Free
01.05.2020	A	Basic Flow	Failure 10% Hardware 25%	Direct In-direct Manual			Jason K. (1242) B	Perry M. (1002) A Rondo J. (1014) B

☐ Admin Edit   Plan 65,000   **Shift inactive**

Primary to Secondary Grading (176.7 / 190.0)

1 2 Smith M.	1 Many H. 2 Sam S.	1 2	1 2	1 2	
Workplace #1	**Workplace #2**	**Workplace #3**	**Workplace #4**	**Workplace #5**	
3 4 Smith J.	3 Jady S. 4 Jones K.	3 4	3 4	3 4	

1 2 Smith M.	1 Many H. 2 Sam S.	1 2	1 2	1 2
Workplace #6	**Workplace #7**	**Workplace #8**	**Workplace #9**	**Workplace #10**
3 4 Smith J.	3 Jady S. 4 Jones K.	3 4	3 4	3 4

Secondary to Finished Goods (62.7 / 75.0)

1 2 Chase M.	1 2	1 2	1 2	1 2
Workplace #1	**Workplace #2**	**Workplace #3**	**Workplace #4**	**Workplace #5**
3 4 Perry J.	3 4	3 4	3 4	3 4

1 2 Parrot J.	1 2	1 2	1 2	1 2
Workplace #6	**Workplace #7**	**Workplace #8**	**Workplace #9**	**Workplace #10**
3 4 Pinky K.	3 4	3 4	3 4	3 4

WP module typical working sample

Module of logistic management – TrailerScale

TrailerScale module allows to manage logistic input and output of material from the factory. This module allows to register incoming deliveries for example by trucks weight and check it at for two main steps, which will be saved in weight certificate of measured information:

There are options to register input weight with Delivery, Delivery part or Order weight registration. Also it's possible to input checked weight at any time with dedicated weight registration.

TrailerScale module allows users to select and update information about current set of trucks located at the factory at general truck court places with its placement times and other parameters. There is also supposed to choose supply department in universal form to make module compatible with any of supply section of Export module departments.

TrailerScale module is equipped with feature to receive weight automatically from connected weight hardware industrial measuring terminal unit of any suitable industrial standard with any applicable connection by network or data cable. This allows to calculate delivered weight automatically as difference between truck arrival and departure weights.