Enhanced Participants' Registration Model on Open Public Events

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Abstract - **The Digital transformation (DT) has challenged most of the Event Management (EM) services at a time when organizers of open public events still faced a lot of manual operations upon registration of the public event's participants. This survey demonstrates a model to increase a level of digitalization and use of technology, with increased self-service level for registered participants and digital data transfer. The model is based on outcomes from the series of several case studies, practical tests and research activities in Latvia, Albania, and Germany. The paper examines different ways how organizers are able to innovate their routine activities and encourage the broader public to learn and use various digital technologies: Radio-frequency identification (RFID), Near-field Communication (NFC), Quick Response (QR) codes and Mobile apps with a purpose to link the physical and the digital world in the one coherent model. In this research the major part of event management process modelling had been done by Business process Model and Notation (BPMN2) approach. The approach proposed by authors aims to reduce the costs and workload of organizers associated with participants' registration in open public events where preliminary registration is still practically impossible or forbidden because of personal data protection issues.**

Keywords - Digital transformation, service-oriented modelling, RFID, sports event management.

I. Introduction

The first obvious conclusion in the age of digital transformation is that almost any traditional human interaction process effectively benefit from integration of digital tools and solutions in the underlying business model. Unfortunately, in real life there are specific cases and applications when human and social influence factors override eventual process digitalization possibility. As one of such specific human interaction models is open public event participants' registration process when eventual participants arrive without prior invitation, pre-approval or pre-registration. In this case, the preliminary registration online is impossible because participants appear just "on-site" before event or such type of registration is forbidden because of personal data protection issues [1]. The subject of the digital transformation and its strategic significance is understood by managers, but questions remain as to how to integrate digital solutions and how to modify business structures to transform into digital organisations [2]. From human interaction prospective registration data flow as an information structure is now the most common term for those aspects of a sentence's meaning that have to do with the way in which the hearer integrates the information into already existing information [3].

This study aims at elaborating existing open public event participants' registration models and methods of the digital transformation process determining whether they are relevant or not in the context of the digital transformation of enterprises.

Constructing the registration data flow-processing model specific number of basic modelling components has to be taken into account concerning abstraction levels and codification of activities. The proposed participants' registration model design is based on recently developed POS (participants-organizers-spectators) model framework [4] and elaborated in the next chapter.

This research paper examines outcomes from several case studies and business applications already implemented in practice or still under the development process. The approach proposed by authors aims to reduce the costs and workload of organizers associated with "on-site" participants' registration in open public events.

II. MATERIALS AND METHODS

Authors of this research used data sets and evidence from development projects administered by them individually or all together:

a) Data sets from experimental sports events series "Latgale Open" (2015-2019) [5] (Table 1):

TABLE 1 SPORTS EVENT SERIES "LATGALE OPEN" STATISTICS

| Year | Registered events and participants | | |
	Number of events	Number of participants	Number of runs
2015	6	522	791
2016	10	765	1100
2017	9	725	1277
2018	14	840	1622
2019	9	595	1535
In total	48	3447	6325

b) Experimental participants registration datasets from Sports study program students' admission exam at the University of Shkodra "Luigj Gurakuqi", Albania, within a period of 2017-2019.

c) Knowledge transfer and innovation process modelling of SPORTident Center system- the worldwide results platform for orienteering events [6].

d) Open public event participants' mobile app for self-registration system (in development, on verification phase) [7].

Nowadays, "Industrie 4.0" modelling concept [8], [9] and complex digital transition process of enterprises [10], [11] are key aspects to increase competitiveness and effectiveness of companies. In times of digital transformation, a company's ability to survive depends upon its ability to continuously adapt its operations, its information system, and even its business model [12]. In this paper authors align theories of business modelling, enterprise modelling and service-oriented modelling in one coherent system to reach the specific aim of research with practical business outcomes.

Society today is entirely dependent on technologies. Every day new and diverse technologies are developed. To invest time and money, it is first necessary to predict the sustainability of technology [13]. Following by latest trends in the business process modelling theory authors propose public events participants' registration system model based on service-oriented business process modelling (SoBPM) approach [14]. Service-oriented Business Model Framework is one of the widely used service-dominant logic based approaches for Business Modelling in the Digital Era [15].

As basis for the development of the proposed model and understanding of necessary "building blocks" were adapted basic POS (participants-organizers-spectators) model framework [4]. The analytic modelling framework of POS formulates basic model concepts and properties (Table 2):

• Concrete concept- "Agent Type";

• Abstract concepts- "Roles", "Permissions", "Responsibilities".

TABLE 2 CONCEPTUAL TYPOLOGY AND DEFINITION OF "AGENTS"

| Agents | Abstraction level | | |
	ROLES	PERMISSIONS	RESPONSIBILITIES
"P" Agents (participants)	Active Agent	Formal and informal rules; Minimal required level of physical and mental conditions to perform tasks	Objective self-assessment of personal physical and mental conditions; Following to orders and directions of "O" Agents; **Application to Registration protocols**
"O" Agents (event organizers, trainers, teachers)	Active /Passive Agent	Specific legislation and administrative orders; Acceptance of municipal and event rules	Event rules setting; Promotion and attracting of participants and spectators; **Registration of participants;** Setting up of competition environment; Safety rules; Technical equipment setting-up and certification; Recording, capture and publishing of results
"S" Agents (spectators, results ex-post users,	Passive Agent	Passive participant, no need of specific permissions	Following to legislation and special administrative orders; Stated formal municipal, school and/or informal family rules; Stated special

Agents	Abstraction level		
	ROLES	*PERMISSIONS*	*RESPONSIBILITIES*
trainers teachers)			orders and rules of event organizers

In the next step authors made a segmentation and detailed analysis of "P" Agents and "O" Agents to identify services and protocols relevant for event registration activity. "S" Agents, as passive agents, do not take part in the formal registration process and excluded from further analysis.

A. **Setting of services and activity protocols for "P" Agents (AP) (participants) and "O" Agents (AO) (organizers).**

a) **Implementation layer (services):**

• Service 1 [S1]: Promotion, partnership agreements, contracting, advertising (online, direct);

• *Service 2 [S2]: Registration of participants into event database (online, direct, ITC system);*

• Service 3 [S3]: Activity environment and specific exercise area setting up (direct, ITC system);

• Service 4 [S4]: Configuration and setting up of ICT support system for a specific event (online, direct, ICT system);

• Service 5 [S5]: Setting up traditional event support equipment, tools, premises and service team (direct);

• *Service 6 [S6]: Basic on-site services of "Agents" during the event (direct, ITC system);*

• *Service 7 [S7]: Special timing, activity registration and results processing service of participants during the event (online, direct, ITC system);*

• *Service 8 [S8]: Final awards and prizes giving ceremony (direct);*

• Service 9 [S9]: Dismounting of event support equipment, tools, premises and cleaning up of event area (direct);

• *Service 10 [S10]: Final and overall results calculations and publishing (online, ITC system).*

Services that use participants' registration data is marked above in *italics*.

b) **Design layer (activity protocols, with identification of related services):**

• *Protocol 1 [P1]: Non-static, changing, and safe mass activity environment, with integrated advanced ITC systems [S1][S3][S9];*

• *Protocol 2 [P2]: Every "P" Agent is involved during exercise with maximum time and efforts [S2][S3][S6];*

• *Protocol 3 [P3]: Variable difficulty of exercises and courses for different ages and classes [S2][S3][S5];*

• *Protocol 4 [P4]: Limited possibility to compare ongoing performance during the race (not to loose motivation for weak participants), results only after finish [S3][S4];*

• *Protocol 5 [P5]: All individual inputs and performances are measured [S7][S10];*

• *Protocol 6 [P6]: Results are processed and published immediately after finish [S4][S7];*

• *Protocol 7 [P7]: Individual and total team results scored and processed [S4][S7][S10];*

• *Protocol 8 [P8]: Organization of separate multi-task exercises with integration into bigger serial events [S1][S7][S6][S10];*

• *Protocol 9 [P9]: All/best participants must be promoted (diplomas, medals, prizes, cups) [S8];*

• *Protocol 10 [P10]: All participants have "correct and fair results" after completing of exercise [S7][S10];*

• *Protocol 11 [P11]: Also incompletely passed courses and exercises counted and evaluated [S7][S10];*

• *Protocol 12 [P12]: Competition environment is sizeable and flexible (all ages, any physical condition, different numbers of participants) [S1][S3][S4][S6][S9];*

• *Protocol 13 [P13]: Event data are digitally recorded, stored and published [S7][S10];*

• *Protocol 14 [P14]: Integrated tools and mechanisms to simple transfer of "Agents" from "passive" to "active" [S2][S4][S6][S8].*

Activity protocols, which use participants' registration data is marked above in *italics*.

B. **Segmentation of "P" Agents (motivation layer), with identification of related activity protocol:**

• **Participants- "children"** (AP1): "eager to get new knowledge" [P1];

"like to explore new things" [P1][P2][P3];

• **Participants- "youngsters"** (AP2): "like to test new challenges" [P1][P3];

• **Participants- "all participants"** (APX):

"humans like to "socializes" [P1][P8][P14];

"humans all the time compete to each other" [P5][P6][P7];

"like to try "stylish" things and modern gadgets" [P1][P13];

"humans like to win" [P5][P6][P7][P9];

"nobody like to lose" [P4][P10][P11];

""team spirit" improves individual performance" [P7][P8];

"no fear or shame during performance" [P4];

"calculated and visible improvements of individual performance" [P4][P8][P13];

"full respected to "Fair play" rules, no possibility to cheat, correct results" [P10].

After summarizing modelling properties mentioned above, authors created "P" Agents (AP) (participants) event activity flow model in BPMN2 notation using ADONIS:CE modelling environment (Fig. 3) (https://www.adonis-community.com/en/) and interactive "P" Agents (AP) (participants)/ "O" Agents (AO) (*organizers*) event activity flow model in BPMN2 notation using ARIS ELEMENTS modelling environment (Fig. 3) (https://ariscloud.com/aris-elements/). The design of the both models is displayed in the next chapter.

III. RESULTS AND DISCUSSION

Statistical analysis of data sets from experimental sports events series "Latgale Open" (2015-2019) [5] (Table 1) indicates a fluctuating number of participants from year to year, but growing average number of participants per event (Fig.1) and significantly growing number of runs (Fig. 2) per Year.
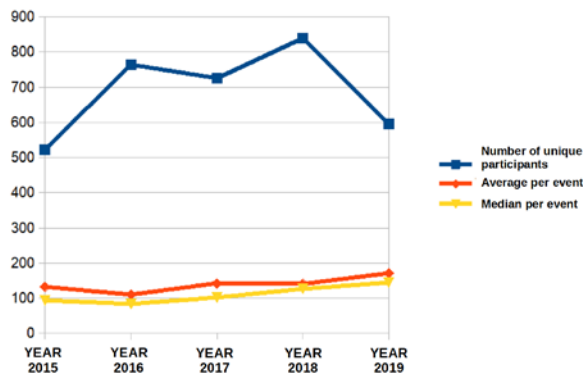

Fig. 1.   Number of participants in experimental event series "Latgale Open".

In real business process activities of enterprise, it means less events with a low number of participants and more events with a high number of participants. Such progress significantly reduce fixed costs per event with relatively small growth of variable costs per participant.
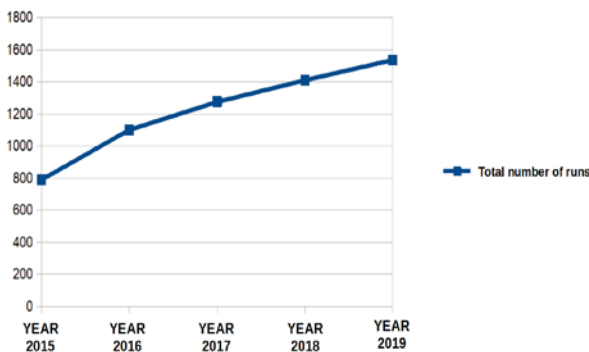

Fig. 2.   Number of runs in experimental events series "Latgale Open".

From experimental data sets there were produced participants' registration timing data analysis in Year 2015. The first registration for each participant had been done manually, with assignment of unique identification number (from 1 up to 9999). After the initial registration, this unique identification number had been associated in digital database with participant's individual properties- name, surname, team/club, start group and, optionally, with personal RFID card number for further use during the next events. Participants' registration timing data statistical analysis had been validated in two different modes- 513 registration cases before start (Table 3) and 499 registration cases after finish (Table 4). Because of statistic analysis software PSPP difficulties dealing with relative time calculation data were converted into decimal form by writing of script:

```
=CONVERT(Xn, "day", "hr"
```

TABLE 3 PARTICIPANTS' REGISTRATION TIMING DATA (BEFORE START)

START_REG	Value	Time
Mean	0.010894520251245	**00:00:39**
Standard Error	0.000278081193116	
Mode	0.006111111111111	**00:00:22**
Median	0.008888888888889	**00:00:32**
First Quartile	0.007222222222222	
Third Quartile	0.010833333333333	
Standard Deviation	0.006298400902756	
Kurtosis	16.3059579171693	
Skewness	3.08518851349957	
Range	0.058611111111111	
Minimum	0.005555555555556	
Maximum	0.064166666666667	
Sum	5.58888888888889	
Count	513	

TABLE 4 PARTICIPANTS' REGISTRATION TIMING DATA (AFTER FINISH)

FIN_REG	Value	Time
Mean	0.011087731017591	**00:00:40**
Standard Error	0.000276538978528	
Mode	0.007222222222222	**00:00:26**
Median	0.008888888888889	**00:00:32**
First Quartile	0.007222222222222	
Third Quartile	0.012083333333333	
Standard Deviation	0.00617741284972	
Kurtosis	17.734126842657	
Skewness	3.18923817163189	
Range	0.058055555555556	
Minimum	0.006111111111111	
Maximum	0.064166666666667	
Sum	5.53277777777779	
Count	499	

From experimental data statistical analysis above, we can draw a conclusion that manual registration of each open

event participant takes almost equal time (39 and 40 seconds respectively) if it is done before start or after finish.

This approach allows for "O" Agents (organizers) to organize the registration process with a higher degree of flexibility to avoid long waiting lines at the start and finish

registry desks (Fig. 3). The next registration model improvement can be done by transfer of registration activity (rights and responsibility) from "O" Agents (organizers) to "P" Agents (participants) in the form of "self- registration" option.
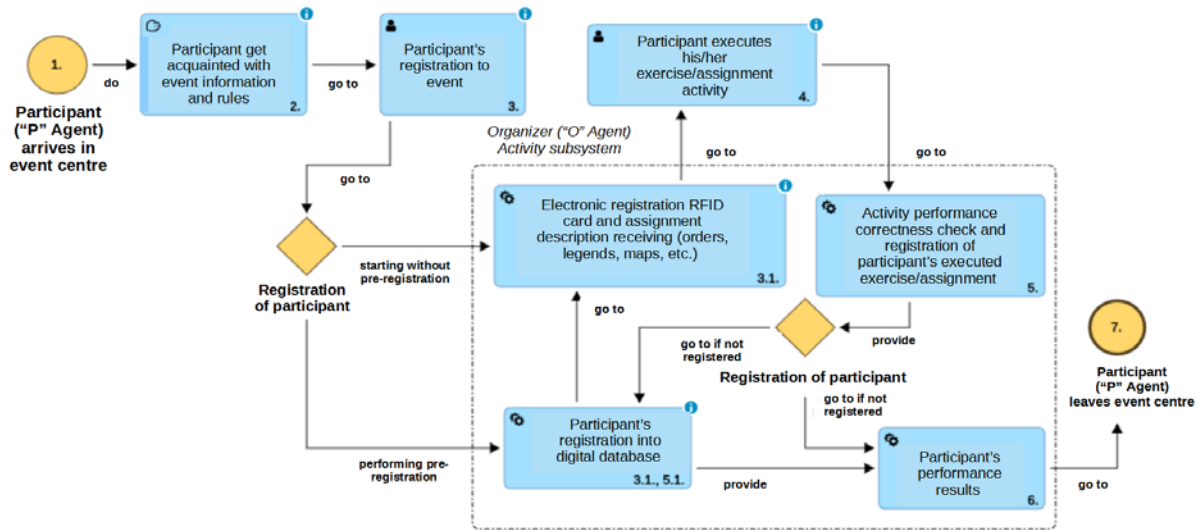

Fig. 3. "P" Agents (participants) event activity flow model in BPMN2 notation (validated in ADONIS:CE modelling environmen
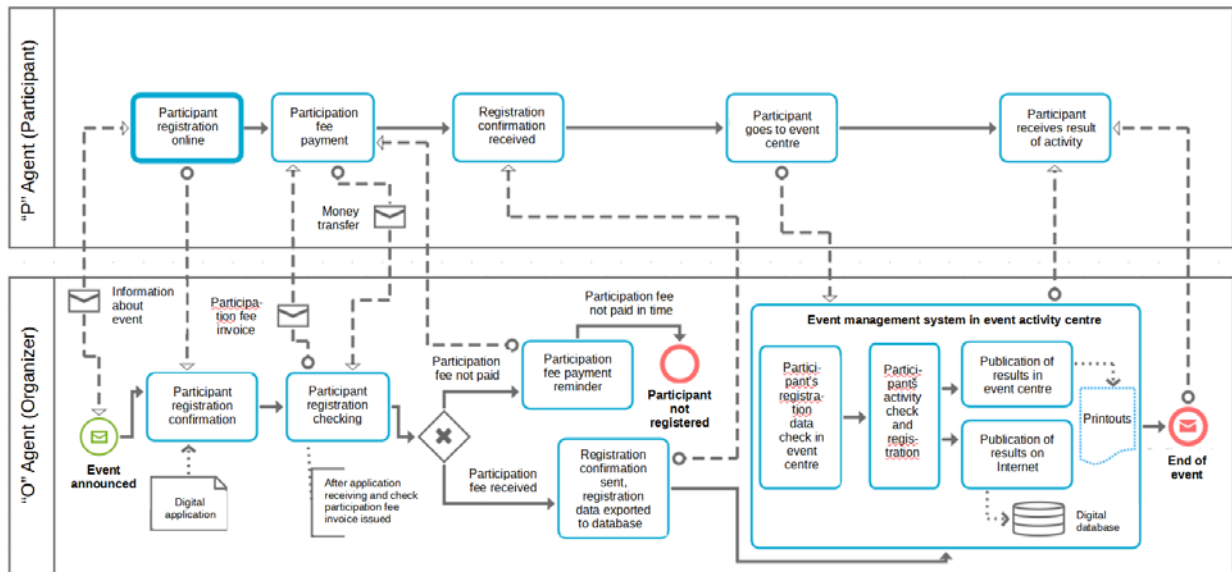

Fig. 4. Online registration activity of event flow model in BPMN2 notation (validated in ARIS Elements modelling environment)

For events with integrated possibility of preliminary registration online (Fig. 4) it can be done easily, but for open events this option does not work because new participants appear directly before or even during event. Authors of this paper proposes extensive use of smartphones for self-registration of participants in open public events. There are already existing such applications at hobby and amateur sports activity market based on technologies like QR codes (QREvents https://sites.google.com/view/azdev/home/user-manual-

qrevents-full), Internet-Bluetooth-GPS integration (MapRunners http://maprunners.weebly.com/quick-guide.html), (iOrienteering (https://www.iorienteering.com/ and others. Such apps are working well for events where timing and activity registration is done by smartphones only, but if there is a need to use external professional sports timing and activity registration equipment, for instance- RFID devices, than still connection of participant's properties (surname, name,

team, start group) and RFID tag identification must be done manually upon self-registration process.

In year 2018 SPORTident GmbH launched "SPORTident Center" results management platform (https://center.sportident.com/), integrated with Android event management system "SPORTident Orienteering App" (https://www.sportident.com/orienteering-app.html). This fully integrated system connects professional RFID timing equipment with event management software on a smartphone (Fig. 5) and "SPORTident Center" data server.

Fig. 5. Integrated SPORTident RFID data readout, event management and results printout system

However, still one major problem persists in all existing systems to make self-registration options for participants on open public events. System is always trying "to couple" two components- participant's properties and RFID tag identification number. In cases when the same tag is re-used again for other runners on mass events, it requests a manual re-registration process once again. As a solution here for open public mass events is assigning of individual participant number upon "self-registration" process which is unique and directly connected only with participant's properties nor RFID tag number. Similar principle is used, for instance, on desktop event results management program SIME (https://www.tak-soft.com/products/sport/sime/) where each participant receives his unique "participant number". The problem here occurs in case of big size participants' databases because, as usual, five or six numbers identification number is difficult to memorize for participants. Considering findings of the latest research in the sports events management area, participant satisfaction is a key factor to take part to pay for and return to well-organized competitions [16], [17], [18], [19].

As an alternative solution authors of this paper, in association with Vidzeme University of Applied Sciences students, had been developed enhanced registration app prototypes. In these prototypes a unique participants' identification is provided upon self-registration process via smartphones in easy memorable form. The identification formed with two letters and one-to-four numbers (example: AA1966- Aigars Andersons, born in 1966), duplicated with individual QR codes, as an option but not coupled with

RFID tag number [20]. Screenshots of prototypes are shown below (Fig. 6). The basic data classes provided by "O" Agents (organizers):

•   D1→ Name of event (mandatory);

•   D2→ Participation classes/groups of event (mandatory);

•   D3→ Distances with identified length and number of controls (mandatory);

•   D4→ Surname and Name of participant from database (mandatory);

•   D5→ Team or club of participant (optional);

•   D6→ Birth data of participant (optional);

•   D7→ Running time of participant (mandatory);

•   D8→ Participant's running time comparison with best running time (optional);

•   D9→ Place occupied by a participant on event (mandatory).
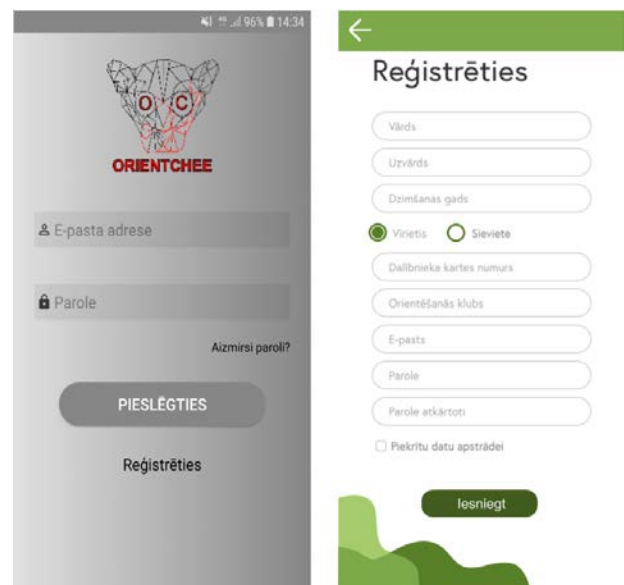

Fig. 6. Screenshots of prototypes for event participants' registration app (on the left- the first prototype of "Orientchee" app, on the right- the latest prototype of "RunReady" app)

The basic data classes input by "P" Agents (participants) upon self-registration:

•   ID1→ RFID tag identification number (optional/mandatory);

•   ID2→ Surname and Name of participant from manual input, database record or RFID tag data (mandatory);

•   ID3→ Participant's class/group to execute (mandatory);

• ID4→ Team or club of participant from manual input, database record or RFID tag data (optional);

• ID5→ Birth data of participant from manual input or database record (optional);

• ID (x1-xn)→ Another relevant data classes of participant from manual input (optional).

IV. Conclusions

On open public events requested mandatory data input from participants, even in "self-registration mode" must be limited according to the General Data Protection Regulation (GDPR), purpose limitation is a requirement that personal data be collected for specified, explicit, and legitimate purposes, and not be processed further in a manner incompatible with those purposes (Article 5(1)(b), GDPR). Visible announcement about participant's voluntary data input must be clearly shown before registration data input.

There are existing significant barriers for participants' registration on open public events where preliminary online registration systems are non-existent or forbidden. In such cases best solution is to provide unique participants' identification upon self-registration process via smartphones in easy memorable form and duplicated with individual QR codes with optional possibility to be tied with specific RFID tag number, Bluetooth or NFC code.

Authors experimented also with computerized terminals for self-registration of participants. In reality, queues at these terminals were much longer than traditionally at the start manual data registration desks. This solution was declined as unsustainable.

For mass open public events registration system must not be limited by one registered cell phone number but the same device can be used for multiple registrations (authors of this research frequently met situations during events with one teacher or trainer and many underage kids with limited Internet data plans for their smartphones or without smartphones at all, in this case registration for all kids had been done from teacher's smartphone).

V. Acknowledgments

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