SPORT TK: Revista Euroamericana de Ciencias del Deporte, vol. 7 n.º 2, (Supl. 2).
Monográfico: Estudios en Gestión y Marketing del Deporte, 9-16
Recibido: Febreo 2018
Aceptado: Junio 2018

ISSN edición web (*http://revistas.um.es/sportk*): 2340-8812

Variables tangibles e intangibles sobre productos y servicios: la creacción de fitness application 'punnett square' (faps)

Product or service tangible and intangible variables: the creation of the fitness application 'punnett square' (faps)

Silvio Addolorato*

IGOID Group, University of Castilla-La Mancha, Toledo (Spain)
Exercise and Sport Science Degree Course, Catholic University of the Sacred Heart, Milan (Italy)

Abstract: Health and fitness (H&F) industry has always highlighted product's tangible variables over untouchable ones. Nowadays conspicuous market models are proving that these facets are increasingly required by international societies and contexts and are demonstrated to be incredibly useful. The applicability and usability of fitness resources (products, services or mixed solutions) depends upon a genuinely innovative approach to the definition of those hidden intangible variables. This literature analysis underline that also academic contributions focus more attention on 'touchable' variables, but it's now the time for the 'B side'. The introduced Fitness Applications 'Punnett Square' (FAPS) tool helps to better understand the ever-growing world of fitness industry resources. It is also direct applicable to all those sector professionals who operate in their daily-life facility routine, with the final goal to increase levels of assessment of H&F product and service knowledge, for what already own and for emergent choices or purchasing actions.
Keywords: Fitness industry, health service, intangible variables, Fitness Applications 'Punnett Square', fitness equipment, market models

Resumen: La industria fitness y salud (H&F) siempre marcó más las variables tangibles de los productos antes de las intangibles. Hoy en día, en los modelos de negocios que funcionan, se ha demostrado como estas resultan increíblemente útiles. La aplicabilidad y usabilidad de recursos fitness (productos, servicios o soluciones mixtas) se planean sobre el innovador enfoque que define estas calidades más escondidas. Esta revisión de la literatura académica tiene el reto de evidenciar este 'lado B'. La introducción de la herramienta nombrada Fitness Applications 'Punnett Square' (FAPS) ayudará a entender de forma mejor los recursos del sector fitness que siguen en continuo desarrollo. También, resultará aplicable a todos los profesionales del sector que utilizan equipos (físicos o menos) en su día a día en instalaciones deportivas. Bien para todo lo que ya está en posesión para aumentar los niveles de valoracción, tanto como para todas las elicciones frente a acciones futuras.
Palabras clave: Equipamiento fitness, Fitness Applications 'Punnett Square', industria del fitness, modelos de negocio, servicios de salud, variables intangibles.

Introduction

The health and fitness (H&F) industry is, nowadays, in a maturation phase (Fallon, 2004) after almost two decades of continuous fresh contributions due to the arrival of new sectoral technologies. Interaction design has directed the H&F industry, intentionally or unintentionally, toward technology-mediated ways of movements and *workouts* (Parviainen, 2011a).

This maturation is visible in every kind of *product* or *service* available. Certainly, this new stage does not precisely represent a slowdown of the innovation processes, but rather a consolidation of the latest developments, mainly provided by private international manufacturing companies and their performances (Takaki, 2005).

A fitness *brand* is composed of a range of knowledge and 'active' amenities (changes, improvements, update) which are the main means of distinction and buyer's loyalty (Kennedy-Armbruster et al., 2011). The mode of transmission within global markets can be either horizontal or vertical, and actively touch three different conceptual spheres: social, cultural, and geographical (Parviainen, 2011a). At the same time, with improvements in living standards, human beings are living longer and life span bring convenient facilities worldwide and not only in 'western' environments (Yoon & Ahn, 2015; Algar, 2017).

Lately, several recognized field 'gurus' confirm that the new recommended 'pill' is physical activity (PA). The question is, with which methods should the population approach exercise, and what composition tools do we have in our hands?

Tangible qualities ('touchpoints') are more common. These, can include fitness equipments, technical devices or flooring (lately this has even included walls, for spaces optimization). *Intangible* qualities concerns the ways in which single workouts are 'chained' together (Parviainen, 2011b). In this second case, key points are more hidden, with experienced and designed choreographies with sought 'cornerstones' such as managerial rhetoric and the nature of standardization (imi-

Dirección para correspondencia [Correspodence address]: Silvio Addolorato. Exercise and Sport Science Degree Course, Catholic University of the Sacred Heart, Milan (Italy). E-mail: silvio.addolorato@gmail.com

tation-based movements and 'positive' repetition tasks) that transform PA into real 'spectacles'.

Sectoral *resources* are internationally standardized. Therefore in gyms, leisure centers, personal training studios, corporate realities, home and hospitality sectors one is likely to encounter the same offering, unless approaching the latest 'boutique' models (Strand et al., 2010; Bennie et al., 2016). Among 'physical' *products* (also defined as 'material-themed') the main equipment categories are: cardio-respiratory, resistance-strength, and 'subsiding' (such as free weights, kettlebells, dumbbells, resistance bands, fit balls, etc.). These apparatuses barely embrace human *coordinative* capacities (balance, proprioception, exteroception, etc.), but rather targeted *conditioning* ones. The *services* ('non-material') include more recently introduced training *concepts* (mainly without classic overloads, but still with an orientation towards cardio and strength abilities), fitness group classes of various derivations (ballet and rhythm, new age disciplines, regulated struggle and its derivates, relaxation, etc.), and so on.

Today it is difficult to make a clear distinction between fitness goods and services (*qualities*) because classes and programs are sold with or without some material support (*resources*) and vice versa (Parviainen, 2011b).

The ultimate goal of this study is to highlight the gap in the knowledge about fitness equipment and what has emerged in published articles in relation to its field 'resources', simultaneously to all which is defined in literature as product 'variables', because little is known about the information available in scientific databases. Against this backdrop, this paper provides a traditional literature analysis on all products' facets: from every material and touchable areas of investigation, until all those intangible variables that currently define and represent this industry's final results. In this context, it has been debated whether sports scientists need to enter this fitness industry sub-sector more proactively.

Methods

Traditional literature analysis is defined as a method involving a comprehensive search for relevant knowledge and articles on a specific investigation argument, and those identified and selected are then appraised and summarized (De Lyon et al., 2017). The final aim is to analyse a large body of literature, in order to understand the current state of the art, in this case regarding - *fitness equipment* - with other specific independent variables, in relation to all those defined *resources* and quality *variables* (material-themed or not) connected to these sectoral products.

For this review, the search was not limited to sports-related journals but included articles located in the areas of communication, design, engineering, IT, management, marketing, material sciences, mechanic, medicine and surgery, and robotics / aerospace.

The analysis started in September 2017, and the latest search was performed on 28th February 2018. Data collection was performed by one independent investigator experienced in international management and marketing of products in the H&F field.

Data sources and searches

Starting with four main databases (Medline, ISI-WoS, Scopus, and Sport Discus), the keywords used for the searches were: *fitness equipment*, *resource*, and *variable*. The first term has been intersected (dependent variable), using a Boolean logic '*AND*', with the remaining two. The references of each selected paper has been assessed to identify other potentially relevant papers that were not included among the indexed databases utilised by using the known 'snowball' technique (Atkinson & Flint, 2001).

With this additional inclusive logic, articles from other electronic investigation sources have been used for the for the enlargement of the literature analysis. The reference list also included papers obtained from: Academic Search Complete, CINAHL, Cochrane Library, PsycINFO, Ergonomic Abstracts, Business Source Premier, Science Direct, and Google Scholar.

The titles and abstracts sorted were screened to remove irrelevant or duplicated publications. The full-text versions of the remaining papers were then read, analysed, and evaluated in detail to identify their eligibility.

Once the relevant publications for the definition of the state of the art were finalised, the Jadad Scale was used to systematically determine the quality of the papers for approval and acceptance (Jadad et al., 1996). The standard set for selection was all articles that earned a punctuation of 3 (or more) points, which is an indication of high quality. As example, if the examined article separately faces only one of the pre-determined search keywords, didn't obtain the minimum score to be listed in the targeted literature evaluation. Having been done entirely by a single reviser, a good standard of the results was sought for analysis selection.

Study selection and methodological quality assessment

The inclusion criteria of the selected articles were as follows: (1) articles have been sorted with no limit on investigation areas; (2) publications related to the content criteria for 'fitness equipment' that were published through academic journals and directly intersected (Boolean logic 'AND') with the topics of 'resource', and 'variable', that should appear in the title, abstract, or keywords; (3) where aims were not included in those topics, has been analysed if has been extensively faced

or treated between the offered contents of the full-text version; and (4) papers written in English (Table 1).

Table 1. Literature analysis criteria and approaches.

Criteria	Adopted approaches
Main topic	fitness equipment
Related topics	[a]resource, [b]variable (Boolean 'AND')
Research methods	databases search, snowball technique
Evaluation method	Jadad Scale
Boundaries defined	[1]title, abstract or keywords include topics (first phase) [2]full-texts content articles analysis (second phase) [3]assessment through Jadad Scale (for articles approved in first and second phases) [4]NOT by investigation areas [5]NOT by period/time frame [6]publications in English

Data analysis

The chosen method enables to identify, analyse, and report themes of meaning from different points of view (De Lyon et al., 2017). Owing to manage eclectic data, the rationale for this approach has been considered as a pragmatic tool for the specificity of the study aims.

Once the publications have been selected, the author proceeded formally on to data extraction. All the papers were categorised according to its nature by the criteria of the reviewer who proceeded to sort them in four main themes: (1) databases; (2) tangible qualities; and (3) intangible qualities. Additionally, starting from the same milestones encountered, among the study findings has also been proposed an (4) innovative way to categorize products inside fitness industry, the Fitness Application 'Punnett Square' (FAPS), not already defined under this point of view until today.

Results

Databases

The starting search exposed 471 publications. However, most were eliminated based on repetitive appearances among the four indexed databases assessed, or article's main topics discrepancy (title, keyword, abstract), or full text contents that had nothing to do with the relevant subject matter for this study. Ultimately, 29 articles met the criteria (Table 2).

Table 2. Number of articles according to the descriptors.

Databases	Keywords			Total	Selected
Medline	fitness equipment	*AND*	resource	30	2
			variable	43	4
ISI (WoS)	fitness equipment	*AND*	resource	0	0
			variable	1	0
Scopus	fitness equipment	*AND*	resource	6	0
			variable	12	1
SportDiscus	fitness equipment	*AND*	resource	245	15
			variable	134	7
Total				471	29

The initial search resulted in 29 articles, of which 19 were used when the previously explained criteria based on intended content was applied. During the last forty years, when considering the decades of publication, an increase in article addressing the topic of interest can be observed (Table 3).

Table 3. Number of publications by analysed decades.

Decades	Publications	
	N	*%*
1978-1987	2	10.53
1988-1997	3	15.79
1998-2007	1	5.26
2008-2017	13	68.42
Total	19	100

From 1978 (lower limit defined during the analysis) to 2007, over a period of thirty years, only 6 articles were published (31.58%). In the last 10 years (from 2008 to 2017) the most has been provided from the final selection, with almost seven articles out of ten (68.42%).

Undoubtedly, the principal focus of the investigation, due to the provided literature lacks, has been in relation to all those intangible variables which could be put in relation to both physical or digital fitness resources.

Tangible Variables

For obvious reasons and societies' request, the scientific literature tends to highlight everything which is labelled as corporal and *tangible*. The main areas of investigation include (in alphabetical order): acoustics, anthropometric (biomechanical and physiological) parameters, brand (attachment, equity, position, and vitality), design specialty, IT aspects (digital interface supports, prior to the latest virtual reality applications), safety and comfort practices, size and mass, and source type or energy storage.

These variables are mainly studied through a process of identification and detection of 'man-machine' problems (including validation, risk and discomfort issues) that manufacturers (technical support departments) try to avoid in every phase of the production. Academic researchers also reflect these industry trends.

In order to amplify the product usability to different groups of consumers, the structure needed to meet the ergonomic requirements, and be planned in order to render the patterns more comfortable (Long et al., 2009). Training on physical apparatus has a similar emphasis on exercise specificity by the required physiological movements (Reilly & Lees, 1984).

A relevant investigation pathway is the one connected to the modern technologies (personal computers of every extraction, tablets, smartphones, etc.) where exercise devices could normally be perceived, even closer, to the people's ways of *workout* (Wang & Su, 2012).

Intangible Variables

For what emerged from the academic literature, the defined 'B side' of fitness resources is represented by all those untouchable aspects of the products that have been created during the last decades. Nowadays conspicuous market models are proving that these *non-material* facets are increasingly required by international societies and contexts and are demonstrated to be incredibly useful, more so than in previous decades. For these reasons manufacturing realities inside fitness industry are lately focusing their attempts in product's improvement especially in these directions.

International guidelines recommend vigorous PA an average of two or three times per week, with 30/45 minutes exercise 'bout' each session, as the recommended duration. Yet, how can *intangible* variables (Figure 1) be prescribed and included into these active ways of move?

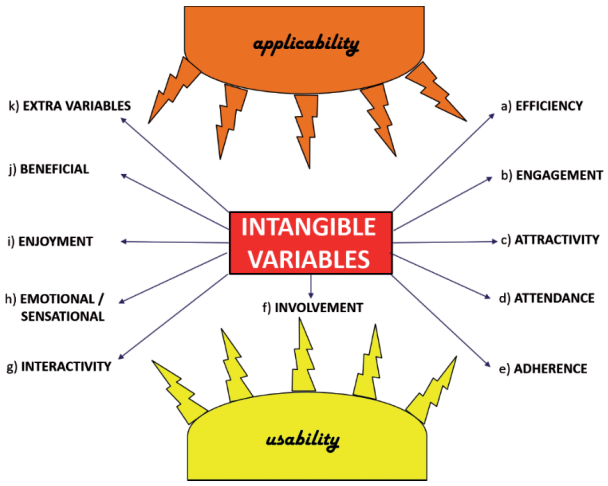


Figure 1. Untouchable and intangible variables (qualities) included in H&F products and services (resources).

Starting with what offered by the selected articles, a complete overview has been enunciated in the following paragraphs. The logical appearance of the variables has been defined based on the appraisal and the induced importance, not by the number of citations obtained for each quality. Moreover, the final scope of this qualitative evaluation is the attempt to unite, with a logical thread, every variable detected in order to provide a more complete vision.

A single workout needs to be (a) *efficient* (Kennedy-Armbruster et al., 2011; Yoon & Ahn, 2015), which includes the sensation of being effective throughout the exercise period. It could be also related to the development of one's muscular-intellectual capacities in terms of recognizing *personal limits* (e.g. physical exhaustion or *burnout*) and overall *functionality* (the real word meaning, and not the latest *functional training* concept brought by PA trends). One of the most high-valued qualities of fitness resources, very commonly highlighted in recent market trends (such as 'high intensity exercise *experiences*'), is the generated (b) *engagement* (Annesi & Mazas, 1997; Sasso & Backus, 2013; Parviainen, 2011a; Algar, 2017). This aspect is correlated with several other 'facets', most of them subjective, i.e. dependent on final user types. More broadly, this feeling could be generated by a sense of challenge or long-term *commitment*, e.g. PA goals based on 'seeing' the progresses (Dibble, 1989).

In various aspects of life, as well as in products and services, human beings detect and choose everything which is labelled as (c) *attractive* (Reilly & Thomas, 1978; Parviainen, 2011a). This topic is explicable through psychological constructs: moving from aroused curiosity, to the real step into *motivation* (defined as the sum of *intensity* and *direction* chosen). Examples of attractive features of the H&F industry include 'sensory' inputs such as music and video feedbacks (Mestre et al., 2011), or the way in which general exercise machineries user sees the same: regular until yesterday, multi-station equipment from today. Another relevant factor is the (d) *attendance* and the *constancy* during the selected quantity of *frequency* (Annesi & Mazas, 1997; Dibble, 1989; Mestre et al., 2011). This aspect should also be understood in relation to the psychological sphere and to specific goals that include 'extra-sectoral' benefits. The next step is the real obtained (e) *adherence* in the planned audience (Park, 1996; Annesi & Mazas, 1997; Mestre et al., 2011, Tsitskari & Tsakiraki, 2013), deeply debated in the scientific literature under the label of *retention*. This variable is strictly related to the constructs of engagement and effective *implication*. Which aspects of the products are generating these subjective mental constructs in every individual? Probably one of the answers is the psycho-physics 'attention' during a specific PA, and it is defined as (f) *involvement* (Park, 1996; Annesi & Mazas, 1997; Mestre et al., 2011, Tsitskari & Tsakiraki, 2013). One of the most widely-used strategies to amplify the potentialities of this fac-

tor is the introduction of the *gamification* (merely playful areas), which not only limited to the developmental (youthful) life span. During standardized PA, for example, this should represent the decontextualization of the game and its extension to other related contexts (with the outcome, for example, of less perceived effort in final consumers).

Moreover, in relation to the involvement variable, there is the basic concept of (g) *interaction* (Annesi & Mazas, 1997; Dibble, 1989; Mestre et al., 2011). This refers to the manner in which any kind of user interfaces with the specific resource, also defined as man-machine (or 'machinic') relation. This aspect could be amplified among more people (peers) at the same time, and be considered in relation to the case of the 'choreographed' services where clients are steered to impersonal co-motion (Parviainen, 2011a). With this market solution instructors are fundamental to keeping people 'on the move' through attractive *personality* and *inter-passivity*. In this specific case, could sector professionals be considered a tangible quality useful to carry out the digital activities? Consumer's attentional focuses are based on 'gaze strategies' (fixation location and time) and, in the meantime, the public do not feel that they are an active part of a 'global machinery'.

Another important variable studied is whether a resource is viewed as (h) *emotional* or *sensational* (Parviainen, 2011a). This is also known as the '*Wow!*' *effect* and, as in the case of attractivity, could represent a real psychophysical necessity which leads users to want it more and more (or investors to bet on it). As in the involvement application, the (i) *enjoyment* sphere is often seen mainly in relation to the youth market; but this view is not evidence-based and partially expired (Dibble, 1989; Mestre et al., 2011). The sense of, or taste for, *pleasure* is inevitably and unconsciously sought in every life stage and, of course, welcomed too during movement and exercises. This variable is strictly related to engagement, of which it could be an effective causative. During recent years, one of the preferred ways of trying to level up this independent factor (and as well long-term maintenance) has been the introduction of *virtual* reality (VR) and, latterly, *augmented* reality. An exercise routine needs also to be (j) *beneficial* in terms of effects and perceived feelings, both during the effective performance and after the 'active interfacing' (Kennedy-Armbruster et al, 2011). Both trained bodies and more normo-type ones, generate a dose of *endorphins* immediately after a classic session. Additionally, when a user includes any kind of PA in their daily life they could see improvements in everyday-living actions, especially in the case of senior-adulthood and elderly categories (kinesthetic homeostasis, joints mobility, etc.).

Additional (k) *extra accompanying variables* (Figure 2), which also benefit all the intangible elements required for the complete 'triumph' of a specific product or service, always need to be reported in relation to a chosen environment or market model (Annesi & Mazas, 1997). Between the main *sensations* and *feelings* that emerge there are seven spheres (in alphabetical order): dissociation (mental), physical exhaustion (endorphins procreation and cells recreation), regulated competition (personal and bidirectional to the activity chosen, or among peer constructs during group exercises), revitalization (physiological and bioenergetic facets), self-expression (body mastery), sense of challenge (interior and exterior), and tranquillity (during, but mostly after workouts).

Figure 2. Extra 'accompanying' variables: sensations and feelings searched and generated in final audience.

Fitness Applications 'Punnett Square' (FAPS)

Despite what detected in the available academic literature, but starting from the milestones included in the same assessment, in this results section seems necessary to redefine a new method to categorize fitness equipments. This concept started from a qualitative evaluation of resource and quality types forms of exercise, that are the basis of the fitness industry applications.

Which insertable evidences are available in relation to the *intangible* (untouchable) variables? Are these aspects relevant to the final *applicability* and *usability* (ultimate aims) of H&F market models?

Economical 'specialty' quality for this sector, has been view

under another perspective, and has been defined as the result of these non-material variables which reflect their potentiality and optimization processes in the daily-life utilization of any kind of fitness resources, and evidently direct related to every sector professionals application.

With the goal of better clarifying the current situation, or at least creating a pragmatic approach to the problem, the Fitness Applications 'Punnett Square' (FAPS) tool has been constructed and introduced, based on the famous and widely-used bio-genetic field approach (Figure 3). This method is founded on the logic of the *dominant* and *regressive* characters of the evaluated variables (in the original case, genes or miscible elements). Using the same logic, this innovative model presents both dominant and recessive facets of resources and qualities with which the fitness industry provides its wide range of movement forms. For convenience tangible/physical variables have been coded as dominants, and intangible/non-material variables as recessives.

Figure 3. Fitness Application 'Punnett Square', variables division in dials.

		Qualities	
		Q	*q*
Resources	*R*	RQ	Rq
	r	rQ	rq

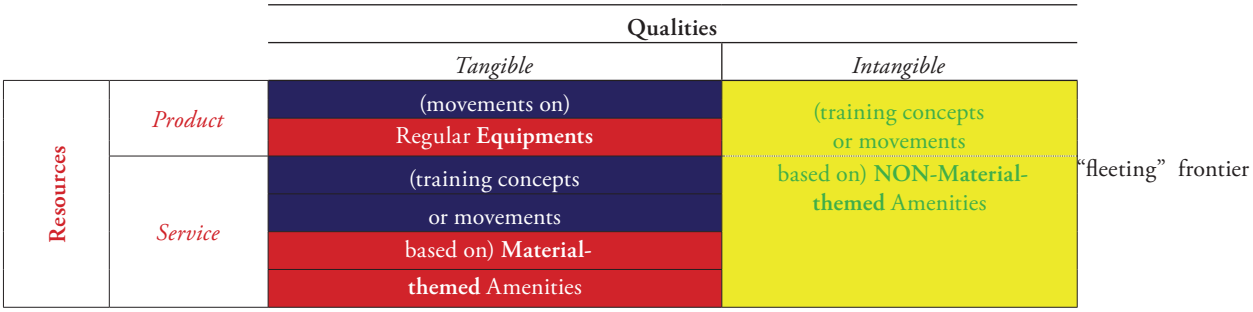
Legend (characters of variables)

X = Dominant

x = recessive

Depending on which kind of activities (macro-areas) are included in each dial (quadrant) it is evident how the recessive character of the enounced qualities (lower case and blue in the image) is the same, and could be shared for both categories (color yellow), cancelling the 'border', of available resources (Figure 4). In this respect, it is right that both academics and corporations should want to discover more in order to plan the and anticipate the next stages of this continuously growing industry.

Figure 4. Fitness Application 'Punnett Square', dial divisions by PA macro-area ways of exercise definitions.



Each dial it is not an autonomous 'world', as chemicals might be, but exists in correlation with other dials and should complements the other practical applications. For this reason, many ways of movement or products (physical or not), included more than one category at the same time.

Discussion

Fitness industry scientific timeline goes 'hand in hand' with the 'real' life development of the sector, in fact the articles begin to appear from the end of the 70's of the past century and arrive until today for a total span of forty years. It is obvious how, with the introduction of the IT in the last decades (Parviainen, 2011a; Wang & Su, 2012), the publications on fitness equipment took broader approaches (with several others sub-fields with which cooperate), but also evidently grow in terms of number of productions (in this case almost 70% produced in the last ten years assessed).

Sport Discus represents the most comprehensive database in which articles have been positively retrieved, and it is an ideal tool for practitioners who carry out researches in the fields of fitness, health and sports studies (with a massive quantity of material also in relation to sports medicine, physiology, psychology, and physical education & recreation).

According to Takaki (2005) it has been evidenced how, nowadays, the limit between fitness goods and service it is evanescent in terms of *resource* extraction, and the main reason is due to the ways in which these means are normally delivered (with or without material support) and embracing the concept of *quality* extraction. The FAPS model underlined how the intangible qualities could be the same for both material or non-material fitness amenities, and this fleeting frontier could represent a real step into the inclusion and evolution of the same resources.

One of the best, in terms of manufacturing industries focuses inside fitness sector, is to create physical products which could also include a wide number of untouchable qualities, but most of processes didn't evaluate other comprehensive

ways to elaborate solutions inside the FAPS dials in cooperation with the remaining ones (opposite or completion processes). For example, in the actual applications available, all the definable support generated by these kind of non-material variables (applied to any resource kind) is still weak, or not developed with criteria.

As encountered in various literature definitions, fitness equipments have always been categorised according to quantitative definition (Strand et al., 2010; Bennie et al., 2016) such as: division for energy/exercise expenditure categories, related physical 'summon' based on PA types, final consumer workouts goals, etc. Today it is possible to amplify these correct sub-divisions also proposing a qualitative approach as introduced in the FAPS method.

Conclusions

This traditional literature analysis offered and enounced a complete vision on *how* fitness equipments qualities have been categorized inside fitness industry. Not only through quantitative or exercise typology assessments, such as energy expenditures or capacities required to work out categories (on a material or untouchable resources), but also facing qualitative facets of the same.

For this reason, depending on the FAPS dial in which a *product* or *service* is included, it is necessary to emphasize specific variables to make sure of their *applicability* and *usability*, and keep them on the 'tracks' required by today's *societies*, *contexts* and *markets*. The FAPS model facilitates new sectoral approaches to better define what already exists and all that will probably come soon (Figure 5). The final aim of the contribution is to stimulate both academics and corporations (in a 'win-win' situation for both entities) to schedule investigations which could include these relevant aspects for the final *economical specialty* applications (public: targeted request, industry: *ad hoc* proposal).

Figure 5. A schematic situational shot on how H&F sector could be defined today.

Among the main phases, in which is necessary to put into practice this innovative model, there are the creation, development, featuring and exploitation of resources inside the fitness industry. H&F sector professionals at all levels should obtain pragmatic benefits, both for what already own and for emergent choices or purchasing actions. But the ultimate goal, is undoubtedly, to arrive until the final consumer which needs new stimulus and is nowadays more and more demanding.

Strengths and limitations

The Author acknowledge both strengths and limitations to the approach adopted for reviewing and analysing the existing literature evidences. The most strength emerged, is the level of flexibility offered by the adopted approach. This has enabled to include a wide variety of information without being impeded by strict or inappropriate inclusion/exclusion criteria. Moreover, the iterative approach allowed us to refine the analysis based on newly discovered material throughout all the analysis duration.

The first limit is in relation to the number of scientific

databases used and the keywords selected, which could have been expanded to include more academic supports, or conversely less strict in the way of including more papers (high acceptance levels).

Another example is the one linked to the nomenclature: during the snowball technique 'rounds' it has been necessary to assess articles which used synonyms in order to include more valid sources, maintaining the same adopted rating scale. Along the same lines, the selection criteria has excluded a wide number of publications emerged from indexed databases. In the most of the case the complete irrelevance was due to the fact that the material was not academic (but equally appeared in databases) and merely represented registered patents or licenses of the products.

References

1. Algar R. (2017). Health Club Industry Active Aging Report. Harnessing the Opportunity of an Aging Society. *Oxygen Consulting*, Brighton (UK), *October*(report), 1-58.
2. Annesi, J.J. & Mazas, J. (1997). Effects of Virtual Reality-enhanced Exercise Equipment on Adherence and Exercise-induced Feeling States. *Perceptual and Motor Skills*, *85*(3), 835-844.
3. Atkinson, R., & Flint, J. (2001). Accessing Hidden and Hard-to-reach Populations: Snowball Research Strategies. *Social Research Update*, *33*(1), 1-4.
4. Bennie, J.A.; Pedisic, Z.; van Uffelen, J.G.Z.; Gale, J.; Banting, L.K.; Vergeer, I.; Stamatakis, E.; Bauman A.E. & Biddle, S.J. (2016). The Descriptive Epidemiology of Total Physical Activity, Muscle-strengthening Exercises and Sedentary Behaviour Among Australian Adults - Results From the National Nutrition and Physical Activity Survey. *BMC Public Health*, *16*(1), 1-13.
5. De Lyon, A. T., Neville, R. D., & Armour, K. M. (2017). The Role of Fitness Professionals in Public Health: A Review of the Literature. *Quest*, *69*(3), 313-330.
6. Dibble, M.A. (1989). Technology of the Fittest. *Machine Design*, *61*(24), 74-82.
7. Fallon, J. (2004). New Thinking on Health and Fitness. *Journal of Retail & Leisure Property*, *3*(4), 307-313.
8. Jadad, A. R., Moore, R. A., Carroll, D., Jenkinson, C., Reynolds, D. J. M., Gavaghan, D. J., & McQuay, H. J. (1996). Assessing the Quality of Reports of Randomized Clinical Trials: Is blinding necessary?. *Controlled Clinical Trials*, *17*(1), 1-12.
9. Kennedy-Armbruster, C.; Marquette, D. & Williams, A. (2011). Project Matrix: Fitness Educators and Fitness Equipment Manufacturers Working Together Innovatively. *ACSM's Health & Fitness Journal*, *15*(4), 18-23.
10. Long, Z.; Zhang, J.; Jin, H.; Hu, Y. & Zhang, J. (2009). Development of a Four-drive Bionic Fitness Bike. *Robotics and Biomimetics (ROBIO)*, IEEE International Conference*, 776-781*.
11. Mestre, D.R.; Maïano, C.; Dagonneau, V. & Mercier, C.S. (2011). Does Virtual Reality Enhance Exercise Performance, Enjoyment, and Dissociation? An Exploratory Study on a Stationary Bike Apparatus. *Presence: Teleoperators and Virtual Environments*, *20*(1), 1-14.
12. Park, S.H. (1996). Relationships Between Involvement and Attitudinal Loyalty Constructs in Adult Fitness Programs. *Journal of Leisure Research*, *28*(4), 233-250.
13. Parviainen, J. (2011a). The Standardization Process of Movement in the Fitness Industry: The Experience Design of Les Mills Choreographies. *European Journal of Cultural Studies*, *14*(5), 526-541.
14. Parviainen, J. (2011b). Women Developing and Branding Fitness Products on the Global Market. *Women and Exercise: The Body, Health and Consumerism*, *5*, 44-59.
15. Reilly, T. & Lees, A. (1984). Exercise and Sports Equipment: Some Ergonomics Aspects. *Applied Ergonomics*, *15*(4), 259-279.
16. Reilly, T. & Thomas, V. (1978). Multi-station Equipment for Physical Training: Design and Validation of a Prototype. *Applied Ergonomics*, *9*(4), 201-206.
17. Sasso, E. & Backus, D. (2013). Home-Based Circuit Resistance Training to Overcome Barriers to Exercise for People With Spinal Cord Injury: A Case Study. *Journal of Neurologic Physical Therapy*, *37*(2), 65-71.
18. Strand, B.N.; Egeberg, J. & Mozumdar, A. (2010). The Prevalence and Characteristics of Wellness Programs and Centers at Two-year and Four-year Colleges and Universities. *Recreational Sports Journal*, *34*(1), 45-57.
19. Takaki, L. (2005). Employee Ownership + Accountability = Competitive Advantage: Precor Drives Organizational Change. *Industrial and Commercial Training*, *37*(3), 145-149.
20. Tsitskari, E. & Tsakiraki, A. (2013). Does Satisfaction Affect a Member's Psychological Commitment to a Fitness Center? *Journal of Physical Education and Sport*, *13*(4), 522-527.
21. Wang, M.H. & Su, Y.T. (2012). Using Extension Method for Health Analysis System of a Fitness Device. *Expert Systems with Applications*, *39*(17), 12833-12840.
22. Yoon, Y.S. & Ahn, H.S. (2015). A Study on Design Development of Environment-friendly Sports Equipment and Convenient Facilities for Seniors. *Journal of the Korean Society of Design Culture*, *21*(4), 465-475.