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C O N T E N T S

Articles and Statements

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Variegated Dynamic Functions as a Blend of Architectural Design and Contemporary Integrated Conceptualization

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Abstract

Fluid structures, dynamic, and organic architectural forms, presents a structure accompanied with functions as a fastening performance which have technologically evolved recent decades in perception of contemporary architecture, resulting with architectural structures that somehow challenge the perception of gravity? Currently, it can be argued that the contemporary dynamic integrated structures can be considered as a 'urban block' in itself, in which we encounter the condensed functional activities that contribute to the social sphere of human activities. The research objective of this paper is to address conceptual design strategies that relate to the multifunctional architectural structures in relation to urban density, variegated dynamic functions as a new style of urban living. The research methods consist of empirical study through spatial planning of Prishtina, and we argue that there is a great potential for further advancement of contemporary trends for the future architectural structures. In this paper, we conceptually conclude that the multifunctional building structures, represent a future methodical architectural design challenges, aiming into a creative process which blend in with many specific varieties, which are both possible and desirable.

Keywords: architecture, design, multifunction, contemporary, urban.

1. Introduction

Fluid structures, dynamic, and organic architectural forms, presents a structure accompanied with functions, a fastening performance which have technologically evolved recent decades on a fundamental ladder in perception of contemporary architecture, resulting with architectural structures that somehow challenge the perception of gravity? Architectural design concepts which result with functional symbiosis, even more, thorough contemporary coupling of totally different functions and elements, bringing constructive stability of structures! This merge, this symbiosis and variegated dynamic functions hybridization generates a new notion of architectural identity features, some different features which evolve and exist at new certain levels, linked to each other in a new conceptual form. Form and functions which originate a new style of living of urbanites in a future megacities.

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Integrated contemporary structures, does not have an authentic scale rate, their recognized organization and composition is directed to multidimensional evolving design concepts, allowing expansion of functions, not just limited to extension or abbreviation of functions. Phenomenon, which results in the dynamic fusion of functions, structures, programs that naturally flow into each other.

"Architectural structures and buildings, especially huge shopping mall structures must prerequisite a more hybridization of functional interrelations in contemporary structures. There is a huge traffic of potential customers in between shopping malls complexes, and urban regional communities, accompanied with different types of functional services such as hotels, airports, and mega terminal structures. The emphasis is on a consistent circulation, a mass movement and circumference." (Bajçinovci, 2016), and there is a difference between mixed-use and hybrid buildings (Fenton, 1985).

2. Material and Methods

Currently, it can be argued that the contemporary dynamic integrated structures can be considered as a 'urban block' in itself, in which we encounter the condensed functional activities that contribute to the social sphere of human activities, environment, and city day to day activities. Hence, those multifunctional contemporary structures represent a fundamental point of interest, common like, visual perception of high structures with vertical and horizontal dynamic features and attributes. Nowadays, the concept of value, the new trends for the city, we seek a new style of living with a new interpretation of architectural concepts. Variegated dynamic functions of architecture re-establishes a new symbiosis between architecture, urbanites and the city in a special way.

3. Results

In the Figure 1 and 2, are presented the possibilities of functional complex and dynamic compositions, variegated functions in terms of flexibility where functional zones and volumes of the structure can be added or removed as dynamically needed.
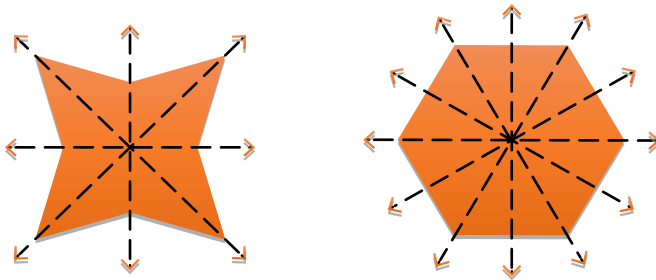
Fig. 1. Composition of surfaces in one spacious zone (Bajçinovci, 2017)
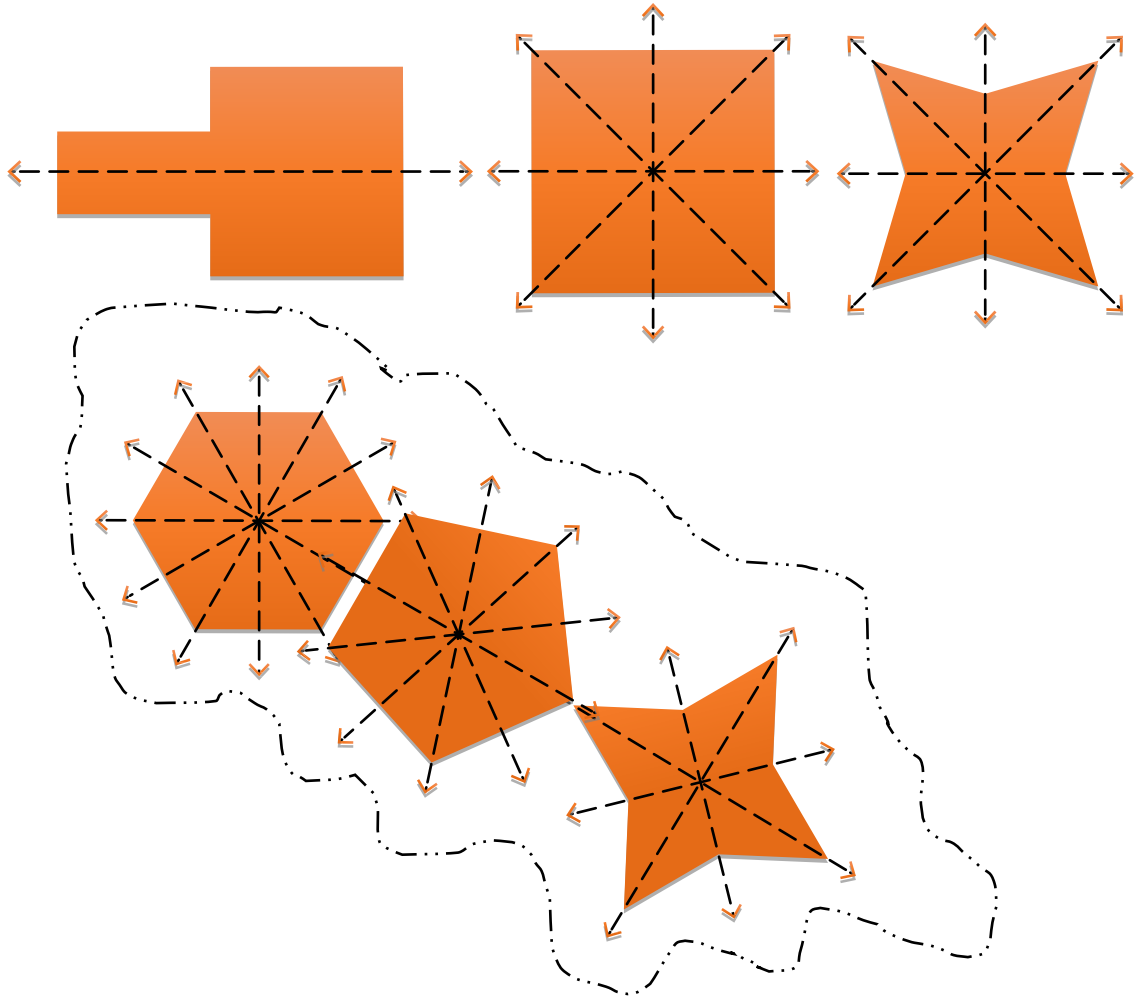
Fig. 2. Blending of zones into one multifunctional entity (Bajçinovci, 2017)
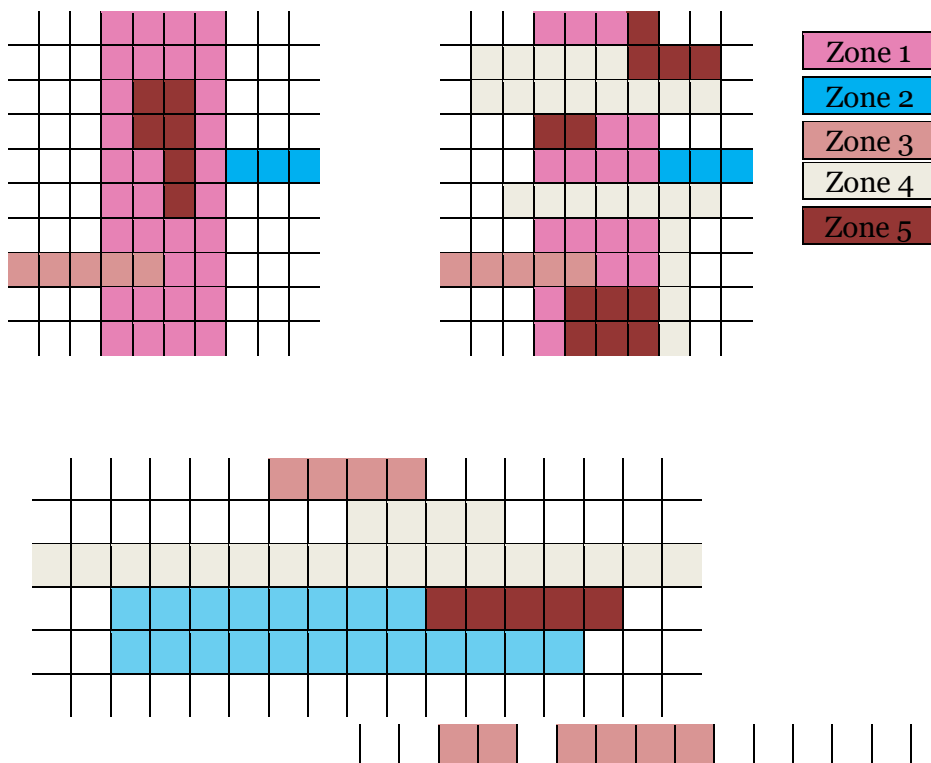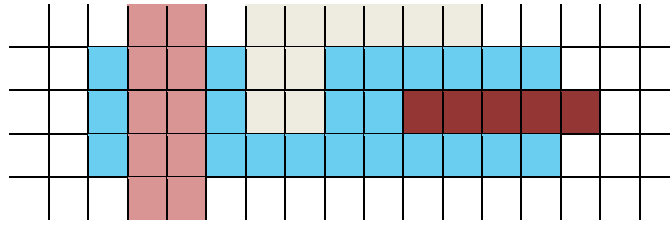
Fig. 3. Varieties of zones, forming multifunctional structures (Bajçinovci, 2017)
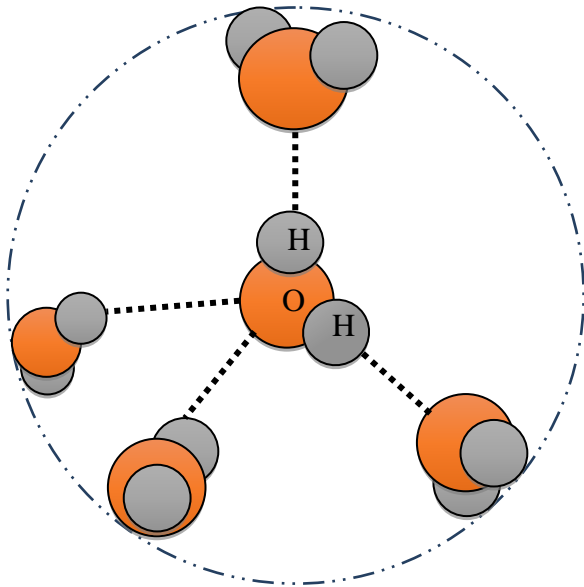
Fig. 4. Model of the hydrogen bonding, (water) (Bajçinovci, 2017)

Variegated dynamic functions goes beyond union functions, with contemporary structures really intended to respond three main concerns of the urbanites, and urban issues to the municipalities:

• Lack of land and their high prices, as a respond to high demands for land area and demands for greater urban density in order to establish a new structures and profit, also contributing to the regional development, community or city.

• Request for something functional specific, engaging architects in building structure programs which are tempting, actions and solutions trying to maximize flexibility of those multifunctional structures.

• Environment, build area zones, used land and existing structures with classic management approaches, also, costs for maintenances of community infrastructures, has forced many municipalities and private institutions to find new ways of building financing, or public private concessions.

Program shapes and forms as conceptual design (French, 1999) actions, nowadays are forcing many subjects to waive certain elements of their individuality? As multifunctional buildings now are being merged into the silhouette of the city together with a new urban life approach. Therefore, multifunctional structures are creating the symbiotic possibilities of having the 'city' within the city, with people at the centre of sustainable development (United Nations, 2011).
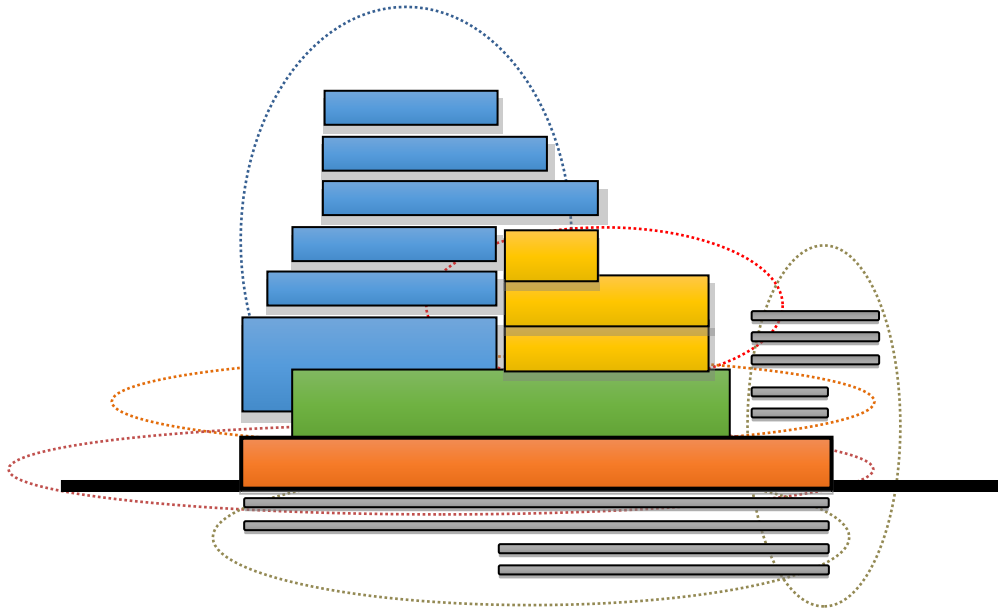
Fig. 5. Multifunctional structure, 'working' 24/7 (Bajçinovci, 2016, 2017)
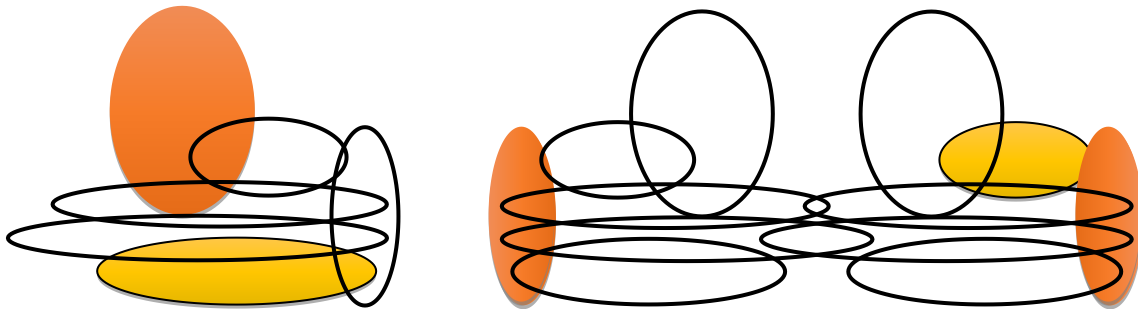
Fig. 6. Varieties of multifunctional concepts, 'working' 24/7 (Bajçinovci, 2017).

The shape and proportions of the structure must be interconnected in a proper relation in the composition of architectural design solution as presented in Figure 6. Moreover, function and forms must be clearly visually stated on the artistic perception on the design programme of future architectural structure. Constantly we are in research process aiming that structural configuration can be realized as a symbiotic consequence of functional solutions, and artistic interpretation which further indicate city evolution (Alfeld, 1995). Function, the ratio of verticality and horizontality, compositional structure configuration must be as the findings and result of a scientific study, an integrated transdisciplinary design research of "techno-cities" (Kargon, Molella, 2008).

	A	B	C	D	E	F	G	H
1.								
9.								
17.								
25.								
33.								
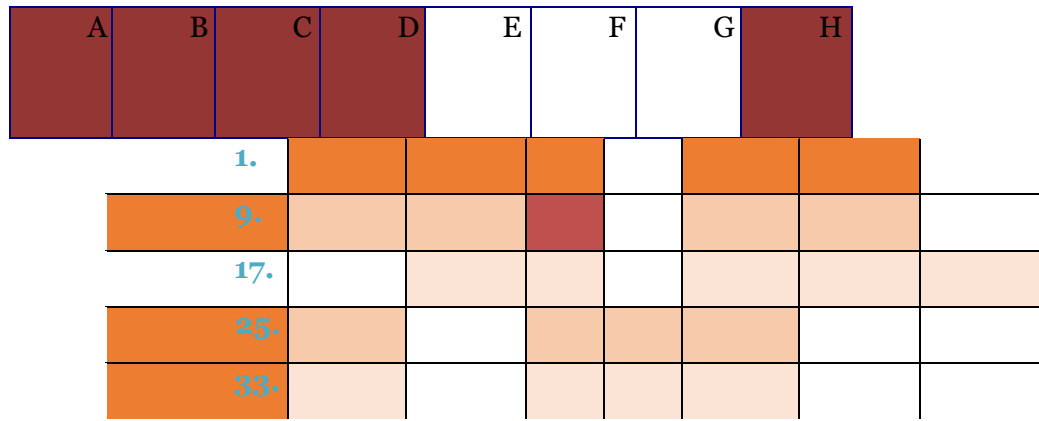
Fig. 7. Variegated of multifunctional zones, 'working' 24/7 (Bajçinovci, 2017)
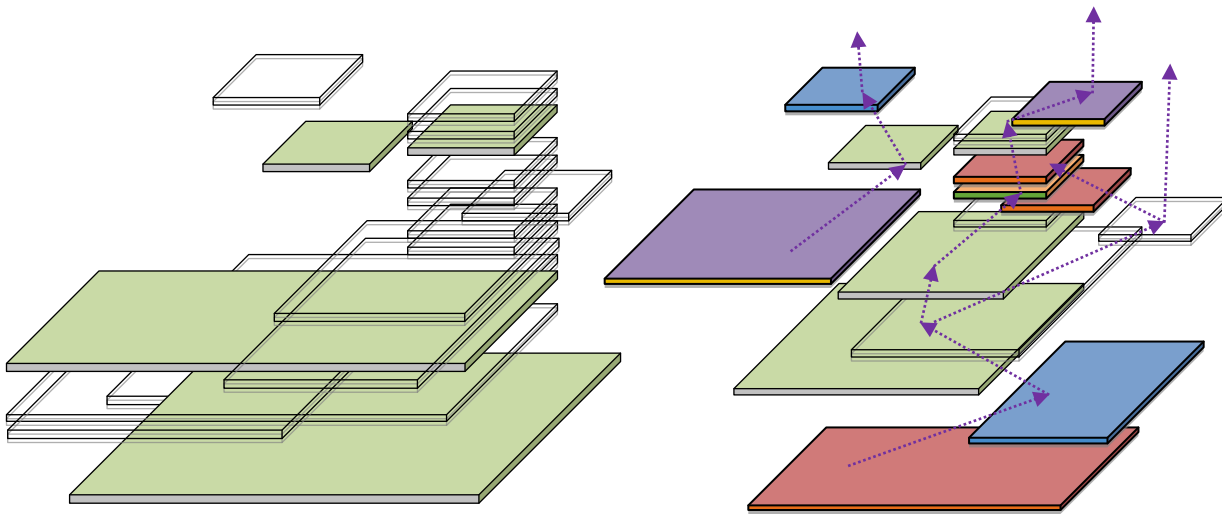
Fig. 8. Blending dynamic functions, 'working' 24/7 (Bajçinovci, 2017)
Fig. 9. Decomposition of functional zones in verticality (Bajçinovci, 2016, 2017)

The research objective of this paper is to address conceptual design strategies that relate to the multifunctional architectural structures in relation to urban density as presented in Figure 8 and 9, variegated dynamic functions as a fastening performance of architectural design and contemporary integrated structures, a new style of urban concepts, and environment impact in relation to the new contemporary design concepts. The research methods consist of empirical study through spatial planning of Prishtina, with significance to the upcoming decades on urban design and spatial planning, moreover, this research was accomplished through literature review.

4. Discussion
The architectural design in his original nature of artistic creative activity, represents the comprehension of intellectual creative process, which especially are attributed to this study, architectural design challenges presented in this paper. This paper is intended to facilitate understanding of architectural contemporary design and achieving functional efficiency in the process of the design, for multifunctional contemporary structures. Respectively, to initiate a scientific understanding of integrated transdisciplinary design strategies, and autonomous goals (Samuelson, 2008). The effectiveness of the architectural design evolution, are resulting on higher quality of research models, considering the implementation of dynamic design concepts for megastructures. We argue that those evolutive design strategies greatly reduces the possible errors in the design process.
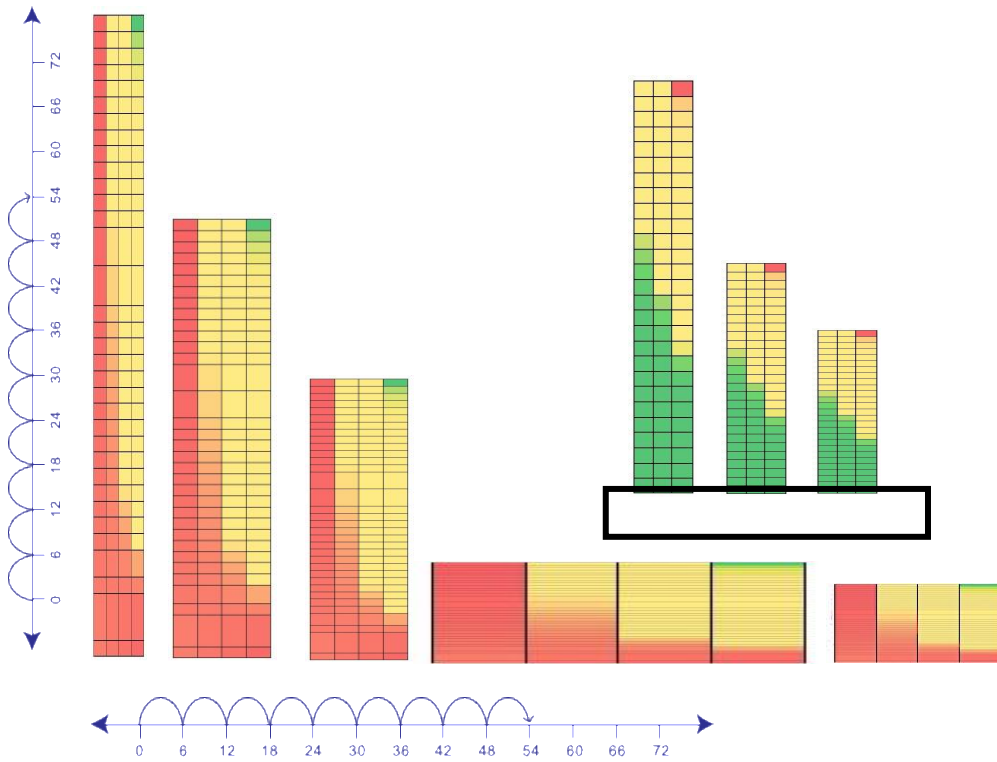
Fig. 10. Variegated dynamic functions, models of structures (Bajçinovci, 2017)
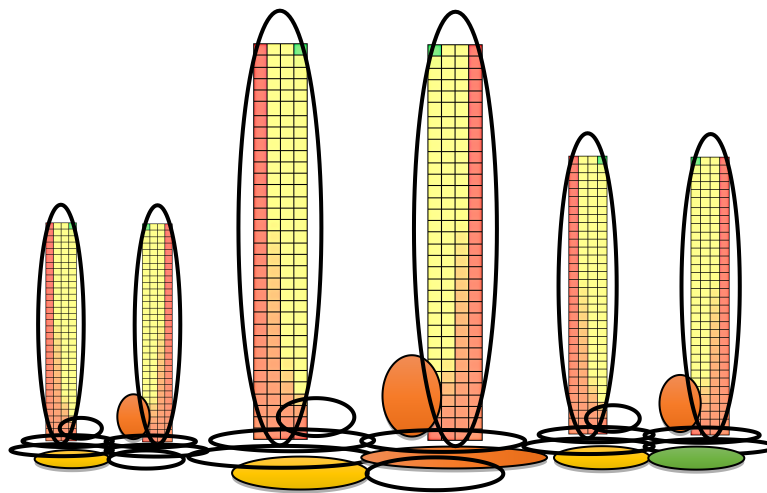
Fig. 11. Variegated dynamic multi-megastructures (Bajçinovci, 2017)
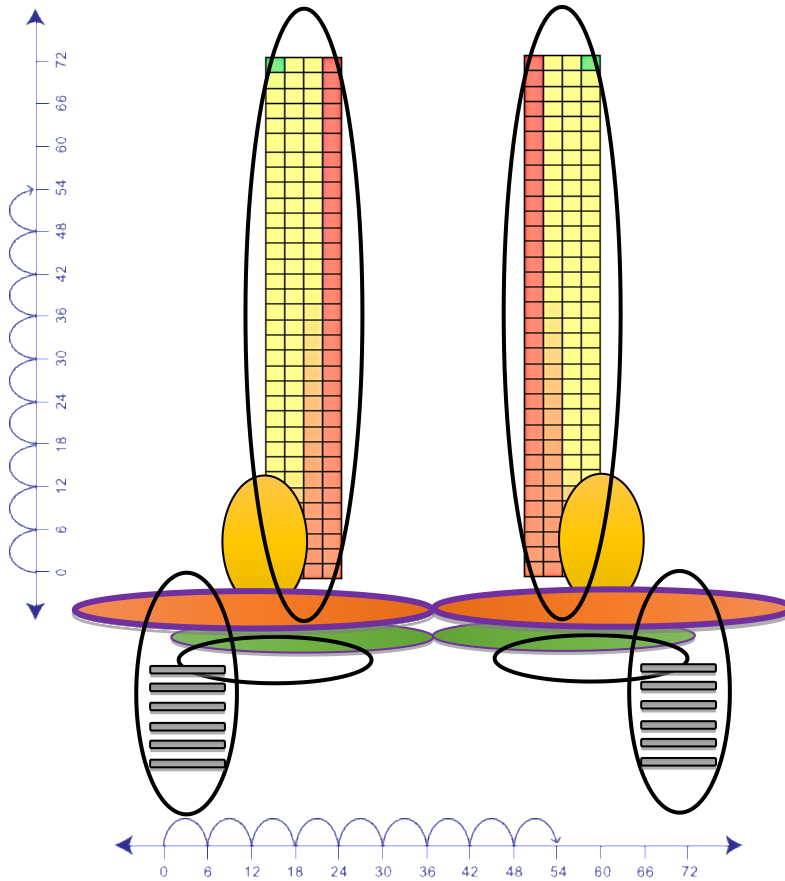
Fig. 12. Interdependence of variegated dynamic structures (Bajçinovci, 2017)
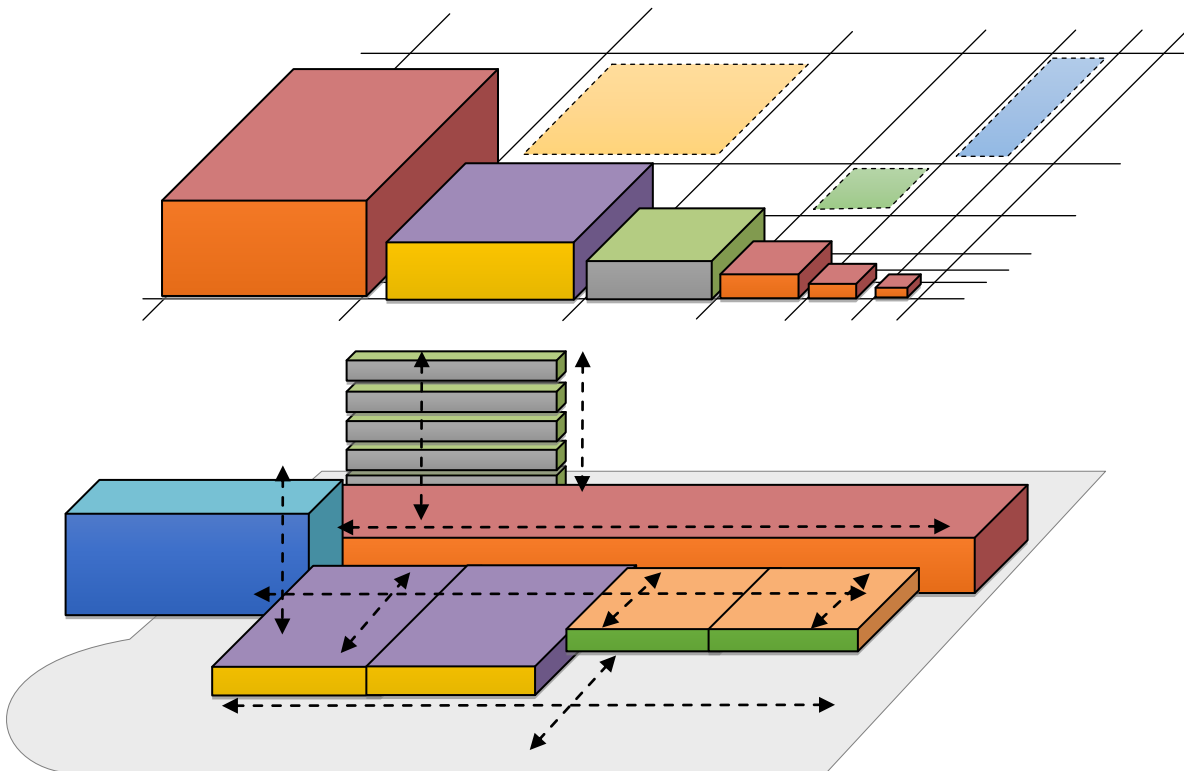
Fig. 13. Forming 3D variegated dynamic functions (Bajçinovci, 2017)
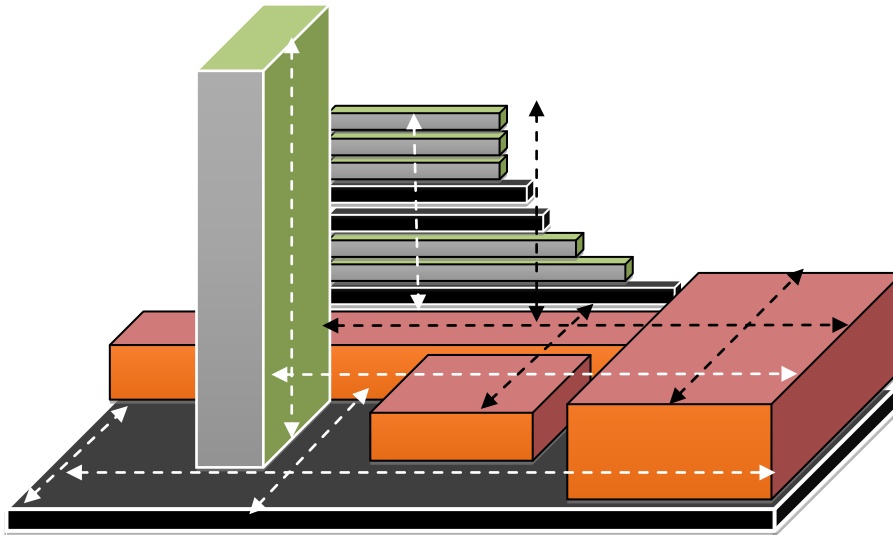
Fig. 14. Interrelations of forming 3D variegated functions (Bajçinovci, 2017)

Multi-functional structures are architecture and urban development that "blends residential, commercial, cultural, institutional, or industrial uses, where those functions are physically and functionally integrated" (Thrall, 2002), furthermore, "well-designed neighbourhoods and communities are places where people need each other" (Orr, 2002).

5. Conclusion

Variegated dynamic functions as a fastening performance of architectural design and contemporary integrated structures, represents structures which are the possible future of architectural design concepts. Hence, those contemporary functionalities of the new life style will be manifested with many social varieties, thus, we argue that there is a great potential for further advancement of contemporary new design trends of future architectural structures, with variegated dynamic conceptual objectives, mentalities, and urban habits? Therefore, we argue that the urban culture, and human development will need some new fundamental transdisciplinary findings, as a respond to the future urban issues! The preferred conceptual design findings presented above, are quite evaluative as to be used for further development, and as a new study. In this paper, we conceptually conclude that the multifunctional building structures, represent a future methodical architectural design challenges, aiming into a creative process which blend in with many specific varieties, which are both possible and desirable.

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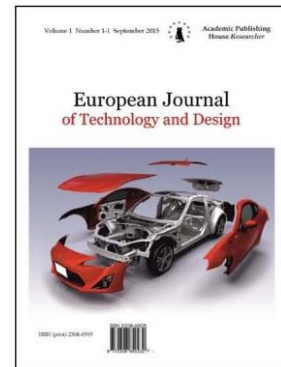
Solution of the Problem of Optimizing the Parameters of Metal Processing during the Turning Operation

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Abstract

The formulation and solution of the problem of optimization of the parameters of metal processing during the turning operation are shown. The task is solved taking into account the level of accumulated wear on the back surface of the tool, the level of machine efficiency that depends on the operating modes and the period of economically effective tool life. The problem was solved in a multicriterial formulation with three objective functions taken into account, the solution was obtained as a Pareto optimal solution. During the solution, an artificial neural network perceptron and the genetic algorithm FFGA were applied. This approach allows solving the problems of optimization of real production.

Keywords: optimization of turning the operation parameters, the accumulated wear of the tool, cost-effective tool life, multi-objective optimization problem, the Pareto-optimal solution.

1. Введение

В последние годы проводится большое количество исследований, направленных на повышение эффективности технологических процессов (ТП) обработки металлов резанием (точение, фрезерование, сверление и т.д.). Одним из основных направлений совершенствования технологических процессов обработки резанием является применение приложений автоматизированного планирования и интеллектуальных систем управления производством, т.к. совершенствование технологических процессов обработки резанием за счет замены оборудования или инструмента является достаточно затратным и зачастую экономически не выгодным. Основным требованием, предъявляемым к системам интеллектуального управления производством, является использование современных компьютерных технологий для формирования и поддержки автоматизированного процесса планирования производства, оптимальное использование оборудования, эффективное прогнозирование операционного времени и наличие альтернативных вариантов ТП (Богуслаев, 2009; Кондаков, 2010; Кроль, 2013).

Технологический процесс механической обработки деталей резанием должен планироваться и выполняться таким образом, чтобы посредством применения наиболее рациональных и экономичных способов обработки удовлетворялись требования к качеству деталей (точность обработки, шероховатость поверхности, взаимное расположение осей и поверхностей, правильность контуров и т.д.), обеспечивающему правильную работу изготавливаемых изделий (Богуслаев, 2009; Кондаков, 2010; Кроль, 2013). Возможности

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современных компьютерных технологий играют значительную роль в удовлетворении этих требований. Одними из таких возможностей являются системы поддержки принятия решений (СППР), позволяющие автоматизировать разработку технологического процесса и управление им.

К функциям системы поддержки принятия решений относятся разработка оптимального технологического процесса изготовления изделия; формирование технологической документации; расчёт затрат времени и себестоимости операции; определение трудоемкости изготовления изделия; расчёт расхода материалов (Богуслаев, 2009; Кондаков, 2010).

Задачи синтеза оптимального технологического процесса решаются в два этапа:
– первый – структурная оптимизация технологического процесса (синтез оптимальной структуры ТП);
– второй – параметрическая оптимизация технологического процесса (определение оптимальных режимов операционных параметров для всех операций технологического процесса).

Структурная оптимизация технологического процесса направлена на создание структуры в виде оптимальной последовательности операций технологического процесса, а целью параметрической оптимизации является поиск оптимальных режимов выполнения операции с учетом всех ограничивающих факторов (Кроль, 2013; Соломенцев, Митрофанов, 2013; Грубый, 2014).

Пренебрежение оптимизацией структуры технологического процесса может привести к значительному ухудшению технологического процесса, его удорожанию и снижению производительности производства. Известно (Соломенцев, Митрофанов, 2013; Грубый, 2014), что эффект от оптимального выбора структуры ТП превосходит эффект, полученный от оптимизации параметров отдельных элементов, входящих в технологический процесс. Это связано с тем, что при ошибочном выборе структуры технологического процесса даже самые современные методы параметрической оптимизации режимов металлообработки не смогут компенсировать потери производительности. В свою очередь пренебрежение параметрической оптимизацией операций может привести к тому, что даже идеальная, на первый взгляд, структура технологического процесса может оказаться недостаточно эффективной (Соломенцев, Митрофанов, 2013; Грубый, 2014).

Процесс резания металлов характеризуется большим количеством параметров и факторов, которые имеют сложную связь и взаимное влияние. Все параметры условно можно разделить на входные и выходные. К входным параметрам можно отнести те, которые непосредственно влияют на характеристики получаемых изделий, а выходными считать те, которые являются непосредственными характеристиками изделия, получаемого в результате механообработки. Учитывая колличество параметров и факторов, входящих в процесс, задачу параметрической оптимизации процессов механообработки металлов резанием можно считать сложной многокритериальной и многопараметрической оптимизационной задачей.

2. Постановка задачи

В работе выполнена постановка и найдено решение практической задачи оптимизации операционных параметров для операций точения поверхности № 5 детали «Корпус фильтра», являющейся составной частью привода-генератора модели ГП-21 (Рисунок 1).
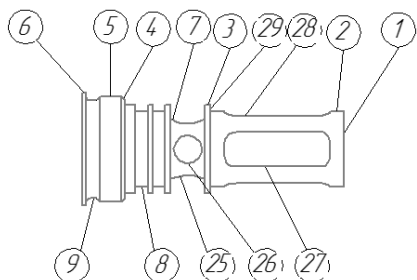
Рис. 1. Условная нумерация поверхностей детали «Корпус фильтра»

Задача расчета оптимальных режимов резания решается путем параметрической оптимизации процесса механообработки изделия на каждой операции технологического процесса. Оптимальным режимом резания является такое сочетание глубины t, подачи S и скорости резания V, при котором обработка выполняется наиболее эффективно при соблюдении всех требований к точности, шероховатости и качеству обработанных поверхностей с учетом технологических возможностей оборудования.

Особенностью постановки задачи в работе является то, что при решении задачи оптимизации, учитывается накапливаемый износ по задней поверхности инструмента – h_3. Такой подход позволяет создать для операций резания математическую модель максимально приближенную к реальной физической модели процесса. Так же при решении опимизационной задачи классический период стойкости инструмента T заменен на период экономически-эффективной стойкости инструмента $T_{эф}$, который определяется как сумма времен эффективного использования инструмента при изготовлении оптимальной партии деталей с учетом изменений режимов резния в зависимости от изменения уровня износа инструмента и изменения $\eta_{ст}$ – коэффициента полезного действия станка, зависящего от режимов его работы.

При оптимизации параметров операций точения учитывалось десять технологических ограничений, которые сформированы на основании работ (Воронцов, Албагачиев, Султан-заде, 2014; Ящерицын, Фельдштейн, Корниевич, 2006).

Ограничение 1. По мощности электродвигателя привода главного движения станка $N_{дв}$.

$$N_{дв} = \frac{F_z V}{60 \cdot 10^3 \eta_{ст}} \leq N_{дв.пасп},\tag{1}$$

где $N_{дв}$ – потребляемая мощность электродвигателя станка, кВт; F_z – тангенциальная сила резания, Н; V – скорость операции резания, м/мин; $\eta_{ст} = \eta_{дв}\eta_{к}$ – коэффициент полезного действия станка, где $\eta_{дв}$ – КПД двигателя станка, %, $\eta_{к}$ – КПД кинематической цепи станка, %; $N_{дв.пасп}$ – предельная паспортная потребляемая мощность электродвигателя станка, кВт.

Ограничения 2-5. По диапазону скорости и подачи операции резания

$$V_{min} \leq V \leq V_{max},\tag{2}$$

$$S_{min} \leq S \leq S_{max},\tag{3}$$

где V_{min}, V_{max} – минимальная и максимальная скорость оборотов инструмента на станке, м/мин; S_{min}, S_{max} – минимальная и максимальная допустимая скорость подачи станка, мм/мин.

Ограничение 6. По прочности режущего инструмента σ_u.

$$\sigma_{max} = \frac{F_z l_И}{W} \leq \left[\sigma_u\right],\tag{4}$$

$$\left[\sigma_u\right] = \frac{\sigma_{о.н.}}{k_{з.п}},\tag{5}$$

где $l_И$ – длинна державки резца, мм; $\left[\sigma_u\right]$ – допускаемое напряжение материала державки резца, МПа; W – момент сопротивления сечения державки резца, мм³; $k_{з.п}$ – коэффициент запаса прочности; $\sigma_{о.н.}$ – опасное напряжение для материала державки, МПа.

Ограничение 7. По жесткости инструмента $f_И$.

$$f_И = \frac{F_z l_И^3}{3E_И I_И} \leq f_{ДИ},\tag{6}$$

где $f_И$ – стрела прогиба державки резца, мм; $f_{ДИ}$ – допустимая стрела прогиба державки резца, мм; $E_И$ – модуль упругости материала державки, Н/мм²; $I_И = \dfrac{B_Д H_Д^3}{12}$ – момент инерции сечения державки резца, мм⁴; $B_Д$ – ширина прямоугольного сечения державки резца, мм; $H_Д$ – высота прямоугольного сечения державки резца, мм.

Ограничение 8. По жесткости заготовки f_3.

$$f_3 = \frac{F_y l_3^3}{k E_3 I_3} \le f_{3.Д}, \tag{7}$$

где F_y – сила, действующая в направлении поперечной подачи, Н; f_3 – стрела прогиба заготовки, мм; $f_{3.Д}$ – допустимая стрела прогиба заготовки, мм; l_3 – длина заготовки, мм; k – коэффициент, зависящий от способа установки заготовки: $k = 3$ – деталь закреплена в патроне; $k = 70$ – деталь закреплена в центрах; $k = 130$ – деталь закреплена в патроне с поджатием задним центром; E_3 – модуль упругости материала заготовки, МПа; $I_3 = 0,05 \cdot D^4$ – момент инерции поперечного сечения заготовки, мм.

Ограничение 9. По прочности механизма продольной подачи станка $F_{x\,доп}$.

$$F_x \le F_{x\,доп}, \tag{8}$$

где F_x – осевая сила резания, Н; $F_{x\,доп}$ – паспортная осевая сила резания, Н.

Ограничение 10. По требуемой шероховатости обработанной поверхности R_a.

$$R_a(V, S, t, h_3) \le R_{a\,max}, \tag{9}$$

где R_a – фактическая шероховатость поверхности при заданных операционных параметрах и фактическом износе инструмента, мкм; $R_{a\,max}$ – максимально допускаемая шероховатость поверхности, мкм; h_3 – износ по задней поверхности инструмента, мкм.

Аналитический вид функций $R_a = f_1(V, S, t, h_3)$ и $h_3 = f_2(V, S, t)$, описывающий их с достаточной точностью трудно формализуем. Поэтому для вычисления R_a и h_3 в работе применена обученная на базе ограниченного количества экспериментальных данных нейронная сеть персептрон с двумя скрытыми слоями (Хавина, Лимаренко, 2013; Лимаренко, Хавина, 2016). Следует так же отметить, что усилия резания F_x, F_y, F_z зависят от накапливаемого износа режущего инструмента по задней поверхности (Воронцов, Албагачиев, Султан-заде, 2014; Song, 2006).

В роботе для параметрической оптимизации операции точения применяются три целевые функции: себестоимость операции A, энергозатраты (потребляемая мощность) Э и производительность операций Q, что позволяет решать комплексно задачи реального производства.

Целевая функция 1. Себестоимость операции A.

$$A = \frac{l_3}{S}\left(a_{раб} + a_{эксп} + \frac{e}{T_{ЭФ}} + \frac{q_э F_z V}{6 \cdot 10^4 \eta_{ст}} \right) \Rightarrow min, \tag{10}$$

где $T_{\text{эф}} = \sum_{1}^{n} \tau_{\text{о}}(V, S, t, h_{\text{з}})$, а n – количество циклов, отработанных инструментом до момента его замены, а эксплуатация инструмента происходит до момента, пока себестоимость операции не перевысит допустимого уровня.

Целевая функция 2. Удельные энергозатраты (потребляемая мощность) Э.

$$\text{Э} = \frac{F_z V}{6 \cdot 10^4 \eta_{\text{ст}}} \Rightarrow \min. \tag{11}$$

Целевая функция 3. Производительность операции Q.

$$Q = \frac{St}{l_3 \Delta} \Rightarrow \max, \tag{12}$$

где Δ – припуск, мм., при этом необходимо учитывать, что при операциях чистового конечного точения $t = \Delta$, т.к. весь припуск снимается за один проход.

Особенностью данной постановки задачи является то, что в работе используется метод расчета сил резания, предложенный в (Song, 2006), что позволяет использовать значительно меньшее количество эмпирических коэффициентов, и с необходимой точностью получить результат, значительно сократив количество дорогостоящих экспериментов.

Сила действующая в направлении продольной подачи – F_x, сила, действующая в направлении поперечной подачи – F_y и главная составляющая силы резания – F_z (Рисунок 2) являются силами, определяющими параметры процесса резания. Зная значения сил можно рассчитать необходимые параметры работы станка, обеспечить оптимальную эксплуатацию оборудования, режущего инструмента и приспособлений.
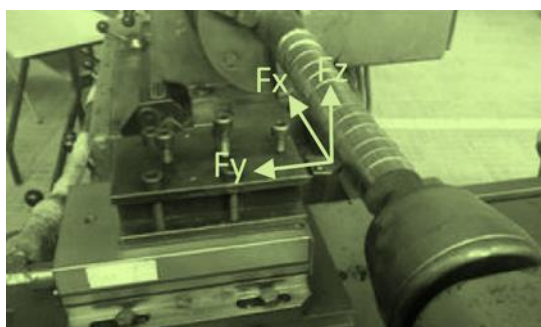
Рис. 2. Схема сил, действующих в зоне резания

Компоненты вектора результирующей силы резания представляются в виде суммы сил, вызванных процессом стружкообразования, взаимодействием закругленного острия режущего клина с обрабатываемым материалом и контактным взаимодействием инструмента с обрабатываемой поверхностью по задней поверхности (на площадке износа):

$$F_x = F_{xs} + F_{xe} + F_{xw}, \tag{13}$$

$$F_y = F_{ys} + F_{ye} + F_{yw}, \tag{14}$$

$$F_z = F_{zs} + F_{ze} + F_{zw}, \tag{15}$$

где F_{xs}, F_{ys}, F_{zs} – компоненты полной силы резания, связанные с процессом стружкообразования; F_{xe}, F_{ye}, F_{ze} – компоненты полной силы резания, связанные с взаимодействием закругленного острия режущего клина с обрабатываемым материалом; F_{xw}, F_{yw}, F_{zw} – компоненты полной силы резания, связанные с взаимодействием изношенной задней поверхности инструмента с заготовкой (Song, 2006).

Наибольшее влияние на изменение параметров операций с течением времени оказывает величина износа инструмента по задней поверхности h_3, т.к. то него зависит уровень сил в зоне резания, шероховатость поверхности, температурные явления, размерная точность получаемой детали и т.п. (Соломенцев, Митрофанов, 2013; Song, 2006).

3. Основная часть

Для решения задачи разработана система поддержки принятия решений «Opticutt». На Рисунке 3 показана архитектура программного комплекса.
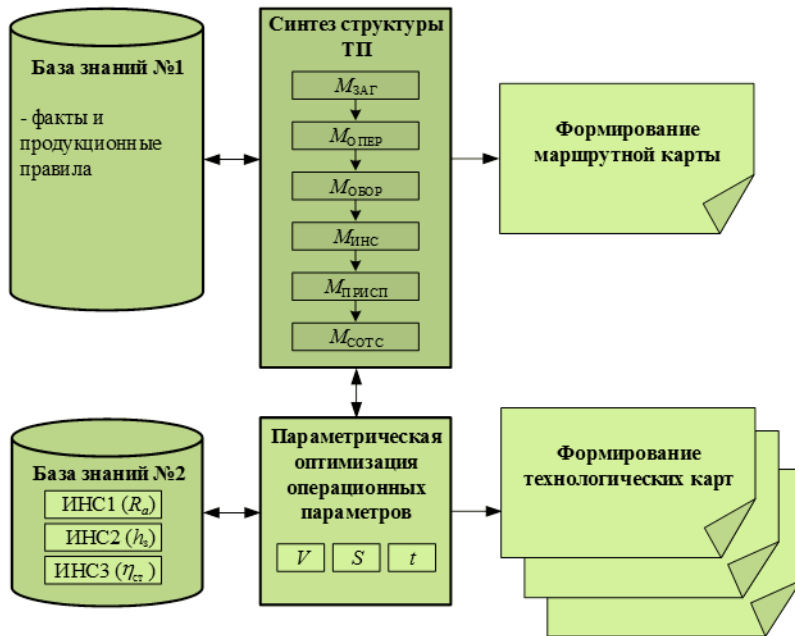
Рис. 3. Архитектура СППР

В СППР входят две базы знаний (БЗ). В БЗ №1 данные представлены в виде фактов языка Visual Prolog. Данная БЗ обеспечивает работу блока синтеза структуры технологического процесса. Блок синтеза структуры технологического процесса связан с блоком параметрической оптимизации операционных параметров, который, в свою очередь работает при поддержке базы знаний №2, в которой хранятся весовые коэффициенты ИНС, необходимые для расчетов КПД станка $\eta_{cт}$, уровня износа инструмента по задней поверхности h_3 и фактической шероховатости поверхности R_a, при этом h_3 функционал от V, S, t, а R_a – от V, S, t, h_3.

Задача решена в многокритериальной постановке путем расчета Парето-оптимального решения, которое позвляет получить решение в равной степени удовлетворяющие требованиям всех целевых функций.

Для поиска Парето-эффективного решения применялся генетический алгоритм Fonseca and Fleming's Multiobjective Genetic Algorithm (FFGA), который обладает хорошей сходимостью и его решения не выходят за область допустимых решений. Метод FFGA основан на процедуре ранжирования индивидов, которая происходит на основе Парето-доминирования. Ранг индивида зависит и определяется числом доминирующих его индивидов (Fonseca, Fleming, 1998).

Для работы генетического алгоритма были разработаны фитнес-функции и структура хромосомы, включающая два параметра – скорость подачи S и скорость резания V. Вероятность мутации одного бита – 7 %; количество особей – 500; вероятность скрещивания – 93 %; Процесс останавливался при достижении точности вычислений $\varepsilon = 0,001$.

Ниже приведены результаты для операции чернового точения поверхности № 5. Входными параметрами являются: диаметр заготовки – 110 мм; сталь – AISI 52100; глубина резания $t = 4$ мм; модуль продольной упругости заготовки $E_3 = 2 \cdot 10^5$ МПа; коэффициент, зависящий от способа закрепления заготовки $k_3 = 2$; модуль упругости материала державки

$E_и$ = 2·10⁵ МПа; марка станков, инструмента, СОТС и др. исходные данные и параметры – из БЗ СППР. В качестве технологических и технических ограничений учитывались ограничения (1)...(9). Технологическая карта для обработки поверхности №5, полученная с помощью СППР, показана в таблице 1.

Таблица 1. Технологическая карта для обработки поверхности №5

Переход	Содержание перехода	Станок	Инструмент (код и наименование)			Режим обработки					
			вспомогательный	режущий	измерительный	T	i	S	t	V	$h_з$
Черновое точение											
065	Токарная с ЧПУ – точить поверхность 5	DMTG-VT30		Iscar CCMT 09T308			2	0,57	4	100	0
							2	0,52	4	128	0,2
							2	0,47	4	147	0,4
Квалитет											
Шероховатость											
СОТС		Cimstar LD 422									
Чистовое точение											
070	Токарная с ЧПУ – точить поверхность 5	DMTG-VT30		Iscar CCMT 09T308			2,8	0,54	2,8	112	0
							2,8	0,504	2,8	128	0,2
							2,8	0,46	2,8	147	0,4
Квалитет	13										
Шероховатость	5										
СОТС		Cimstar LD 422									
Суперфинишное точение											
075	Токарная с ЧПУ – точить поверхность 5	DMTG-VT30		Sandvik CB7015 S01020			0,2	0,17	0,2	200	0
							0,2	0,155	0,2	275	0,2
							0,2	0,141	0,2	315	0,4
Квалитет	7										
Шероховатость	0,64										
СОТС	нет										

Для черновой обработки поверхности №5 были определены следующие станок, инструмент и СОТС: станок DMTG-VT30; инструмент Iscar CCMT 09T308; СОТС Cimstar LD 422. Для параметров управления были определены следующие значения: глубина резания t = 4 мм, Δ = 2 мм.; скорость резания станка: для острого инструмента V = 100 м/мин; для инструмента с износом $h_з$ = 0,2 мм V = 128 м/мин; для инструмента с износом $h_з$ = 0,4 мм V = 147 м/мин; скорость подачи станка: для острого инструмента S = 0,57 мм/об; для инструмента с износом $h_з$ = 0,2 мм S = 0,52 мм/об; для инструмента с износом $h_з$ = 0,4 мм S = 0,47 мм/об; стойкость инструмента $T_{ЭФ}$ = 46 мин.

На Рис. 4-5 приведены сравнительные результаты использования рассчитанных параметров, на основании которых можно сделать вывод, что режимы точения, полученные СППР, более эффективные, чем режимы, применяемые в базовом технологический процессом или режимы рекомендованными фирмой производителем инструмента «Iscar» (Iscar…).
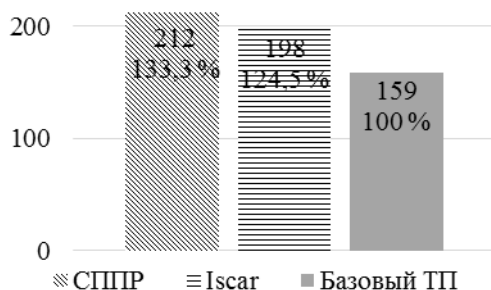
Рис. 4. Количество обработанных деталей за период стойкости инструмента при черновом точении
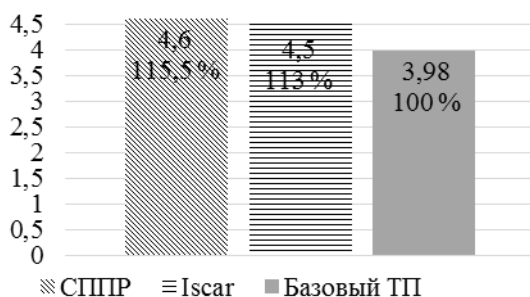
Рис. 5. Производительность операции чернового точения Q при использовании различных операционных режимов

Для операции чернового точения была выполнена верификация полученных результатов. Определялись оптимальные операционные режимы для многоинструментального станка Spinner PD/C и токарного станка SMTCL CA6150B/1000 с использованием инструмента Alberg CCMW 09T308. Результаты расчетов приведены на Рису. 6-7, где показаны уровни себестоимости и энергозатрат операции чернового точения при различных режимах обработки.

Результаты позволяют сделать вывод, что конкретное решение, полученное с помощью СППР, является лучшим из возможных, т.к. в случае выбора другого инструмента либо оборудования наблюдается уменьшение $T_{эф}$ и количества деталей, производимых за время $T_{эф}$, а также увеличение энергозатрат на операцию и себестоимости операции.
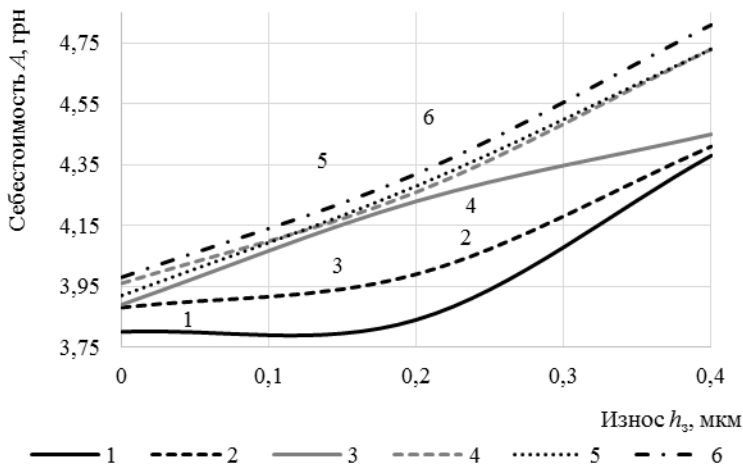
Рис. 6. Себестоимость операции чернового точения при разных операционных параметрах, где 1 – станок и инструмент, рекомендованные СППР 2 –станок, рекомендованный СППР, инструмент Alberg CCMW 09Т308; 3 – станок Spinner PD/C, инструмент Iscar CCMT 09Т308; 4 – станок Spinner PD/C, инструмент Alberg CCMW 09Т308; 5 – станок SMTCL CA6150B/1000, инструмент Iscar CCMT 09Т308; 6 – станок SMTCL CA6150B/1000T, инструмент Alberg CCMW 09Т308
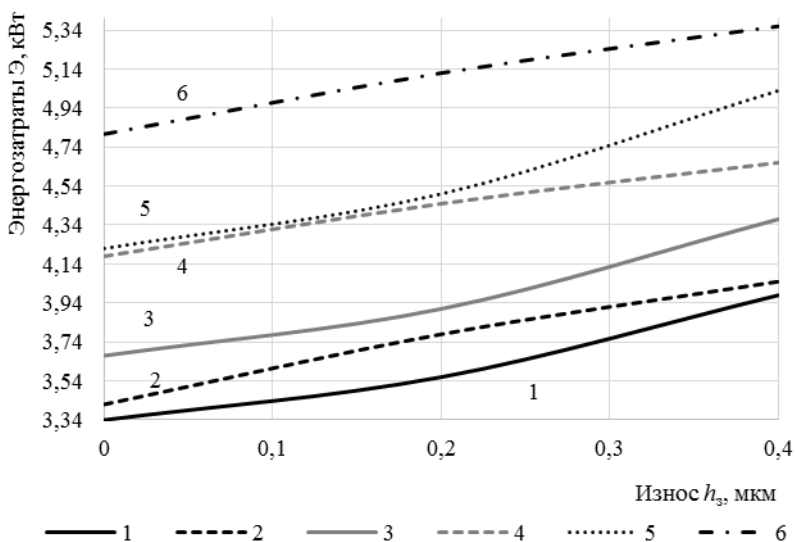
Рис. 7. Энергозатраты на операцию чернового точения при разных операционных параметрах, где 1 – станок и инструмент, рекомендованные СППР 2 –станок, рекомендованный СППР, инструмент Alberg CCMW 09Т308; 3 – станок Spinner PD/C, инструмент Iscar CCMT 09Т308; 4 – станок Spinner PD/C, инструмент Alberg CCMW 09Т308; 5 – станок SMTCL CA6150B/1000, инструмент Iscar CCMT 09Т308; 6 – станок SMTCL CA6150B/1000T, инструмент Alberg CCMW 09Т308

На Рисунках 8-9 показаны затраты времени и суммарная себестоимость производства детали «Корпус фильтра» при различных операционных параметрах. Время, затрачиваемое на производство одной детали «Корпус фильтра» при использовании ТП, полученного с помощью СППР, на 5,2 % меньше, чем при использовании базового ТП. Суммарная себестоимость производства детали «Корпус фильтра» тоже уменьшилась с 613,33 грн. до 527,47 грн., что дает экономию 14 %.
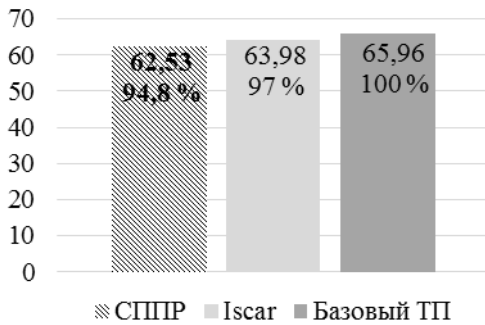
Рис. 8. Время, затрачиваемое на производство одной детали «Корпус фильтра» при различных операционных параметрах, мин
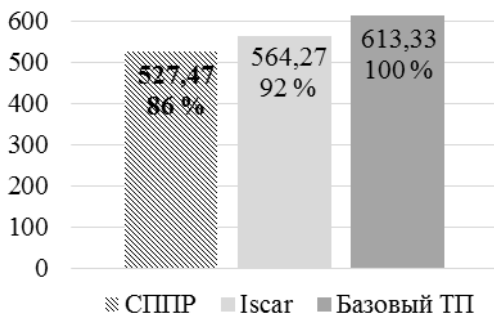
Рис. 9. Суммарная себестоимость производства детали «Корпус фильтра» при различных операционных параметрах, грн

На основании данных, приведенных на Рис. 8-9 можно сделать выводы об эффективности решений, полученных с помощью СППР по сравнению с решениями, предложенными в базовом технологическом процессе или решениями, предложенными фирмой-производителем инструмента «Iscar» (Iscar...).

В результате расчетов были получены оптимальные параметры режимов для операции точения, применение которых позволяет сократить время изготовления детали на 5,2 %, себестоимость операций на 14 %, при этом средний срок эксплуатации инструмента повышается на 11,83 % по сравнению с режимами базового технологического процесса.

4. Выводы

В работе показана постановка и решение задачи определения оптимальных параметров операций точения, где учитывались: накапливаемый износ инструмента по задней поверхности, период стойкости инструмента и изменения коэффициента полезного действия станка. Постановка задачи осуществлялась в виде МОЗ с тремя целевыми функциями: себестоимость операции, энергозатраты и производительность операций. Результаты получены путем расчета Парето-оптимального решения с помощью генетических алгоритмов. Такой подход позволяет решать комплексно реальные задачи производства.

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Решение задачи оптимизации параметров обработки металлов при операции точения

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Аннотация. Показана постановка и решение задачи оптимизации параметров обработки металлов при операции точения. Задача решена с учетом уровня накапливаемого износа по задней поверхности инструмента, уровня КПД станка, зависящего от режимов работы и периода экономически-эффективной стойкости инструмента. Задача решалась в многокритериальной постановке с учетом трех целевых функций, решение получено в виде Парето-оптимального. В ходе решения применялись искусственная нейронная сеть перцептрон и генетический алгоритм FFGA. Такой подход позволяет решать задачи оптимизации реального производства.

Ключевые слова: оптимизация параметров операции точения, накапливаемый износ инструмента, экономически-эффективная стойкость инструмента, многокритериальная оптимизационная задача, Парето-оптимальное решение.
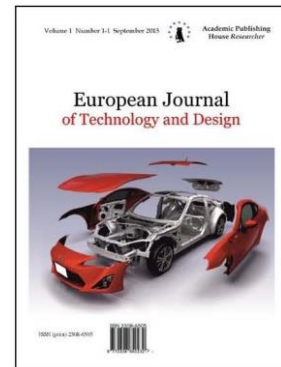
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Communication Technology Adopted in Four Industries in Northern Peninsular Malaysia

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Abstract

Arguably, communication technologies serve as the backbone of organizational dynamics. This research examined the effectiveness of using certain communication technology to communicate at work, such as electronic mails, intranet, newsletter, memos, faxes, manager, voicemail, and phones in hotlines and co-workers. The study also looked into statistically significant differences in communication technology effectiveness when the respondents were grouped by age, type of industry, and job function. A total of 55 respondents working in four industries, namely, logistics, manufacturing, services, and trading in Bayan Lepas Industrial Zone, Northern Peninsular Malaysia, completed the questionnaire. The findings revealed that a mixture of communication technology was perceived to be effective in different industries, and that the respondents' perceptions seemed to be not consistent when grouped by age, type of industry, and job function.

Keywords: communication, technology, manufacturing companies, Malaysia.

1. Introduction and Theoretical Groundwork

In any organizational dynamics, communication seems to be the most complex, if not the least understood, element of social relationship and interaction. This can be attributed to its sociological nature, which takes form and interpretation in various perspectives. Simply put it, communication involves the transfer of information, and information is transferred through the use of symbols, which can be verbal, non-verbal, or both. In depth, however, communication is more than just symbols per se. Communication technologies enable communication to be understood, to be facilitated, and to bridge relationships at work and elsewhere.

According to Ross (1983), communication is a process involving the sorting, selecting and sending of symbols in such a way as to help listeners perceive and recreate in their own mind the meaning contained in the mind of the communicator. Communication is dynamic and ongoing, functional and purposeful, and social and complex. These interrelated processes, assert Ivancevich, Konopaske, and Matteson (2005), assist organizations to accomplish both individual and collective goals, implement and respond to organizational change, coordinate organizational activities, and engage in virtually all organizationally relevant behaviors. In many companies in the US, new employee orientation programs represent the first important opportunity to begin the process of effective communication with employees. At Marriott International, for instance, the rate of employee turnover has been significantly reduced because the company has embarked on a

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concerted effort to improve the content and manner in which the management would communicate with new employees during orientation (Ivancevich et al., 2005).

Wagner and Hollenbeck (2005) cited that 75 % of a manager's time is spent on meetings and telephone calls. Seemingly, nowhere is technology having a greater impact on the workplace than in the area of communication technologies. Facsimile, e-mail, and mobile phones all reduce the need for travel among executives, businessmen, and professional workers, yet make these people more efficient when they must travel. At Pitney Bowes, Inc., for example, copy machine repair workers carry wireless data terminals that enable them to tap into a database while they are servicing remote repair jobs. It was estimated that the system has improved productivity by 15 % and simultaneously increased customer satisfaction.

A simplified communication model (Figure 1) proposed by Sanford, Hunt and Bracey (1976) focus on five important situational variables that influence the potential success of a communication exchange, namely:

- Climate in which communication takes place;
- The perceived communication purpose of the sender and receiver;
- The communication skills demonstrated by the sender and the receiver;
- Whether the message has been intentionally or unintentionally transmitted;
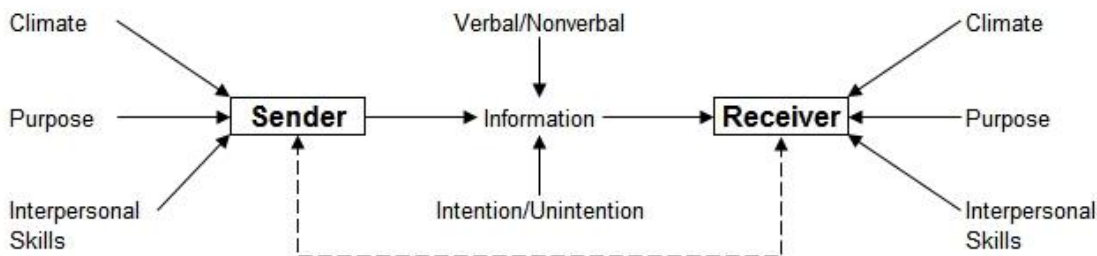- Whether the message is verbal or non verbal.

Fig. 1. Basic Communication Model

Apparently, the model presents seven important elements in communication process, namely, sender, receiver, message, purpose, climate, feedback and channel. Channel refers to the medium used in conveying information from a sender or transmitter to a receiver. In every organization, communication occurs constantly and is a vital process in every organization. People at work spend a great deal of time communicating with each other in meetings, over the phone, via e-mail, and face-to-face interaction, to name a few. Formal channels of communication include written documents, meeting, and teleconferences, while informal channels of communication are best thought of as grapevine. In all these elements, communication technologies facilitate ease and understanding in the dynamics of communication.

Different communication channels or technologies are different with regard to data capacity (the maximum amount of data that can be contained) and information richness (the ability of the medium to convey the meaning or evoke meaning in the receiver). Table 1 compares different communication technologies with regard to data capacity and information richness.

In any organization, communicating effectively is of utmost importance. Communicating effectively means being able to send a message across the organization that is easy to understand and accurate. When communication flows accurately and effectively, the organization will run smoothly. However, if there is a breakdown in the flow of communication, or the information is not accurate, the organization is likely to encounter problems on performance or human relations. Arguably, communicating effectively implies using appropriate communication technology.

Table 1. Information Richness and Data Capacity of Communication Technologies

Communication Mode	Information Richness	Data Capacity
Face to face discussion	Highest	Lowest
Telephone	High	Low
Electronic mail	Moderate	Moderate
Individualized letter	Moderate	Moderate
Personalized note or memo	Moderate	Moderate
Formal written report	Low	High
Flyer or bulletin	Low	High
Formal numeric report	Lowest	Highest

Source: Gerloff (in Daft, Lengel, 1984)

In today's business, the company's complex organizational structures, effectiveness of internal communication, and communication flow, have become a challenge. By developing an effective communication technology system, the information can be shared and transmitted accurately that will foster a productivity-driven working environment.

2. Objectives of the Study

The main purpose of this research was to look into the effectiveness of using communication technology in the four industries in Bayan Lepas Industrial Zone, Penang, Malaysia. Specifically, the study sought answers to the following questions:

1. What communication technology was used frequently in the four industries (logistics, manufacturing, services, and trading) identified?

2. What communication technology was perceived to be effective in communicating at work when the respondents were grouped by (a) age, (b) type of industry, and (c) job function?

3. Methodology

Research Design. This research was descriptive-survey in nature. It described, assessed and compared the frequency of usage and perceived effectiveness of different communication technology. As defined in Learn.Org (2017):

Communications technology, also known as information technology, refers to all equipment and programs that are used to process and communicate information. Professionals in the communication technology field specialize in the development, installation, and service of these hardware and software systems. Individuals who enter this field develop an understanding in the conceptions, production, evaluation, and distribution of communication technology devices.

Respondents. The respondents covered were those from the following industries: logistics, manufacturing, services, and trading. A total of 55 employees holding managerial or supervisory positions as well as non-supervisory job classifications participated in this research. Most of them were from multinational companies (MNCs) located in Bayan Lepas Industrial Zone, Penang Island in the Northern Peninsular Malaysia. The actual sample size was 30 % of the target samples and is considered adequate in descriptive researches.

Data Collection. The questionnaire consisted of selective 12 questions where the first four questions examined how frequent the respondents used face-to-face interaction, electronics communications, written communications and telephone calls. Questions 5 to 12 were to evaluate the effectiveness of different types of communication technologies in their daily work.

3. Findings

Frequency of Communication Technology Use. When respondents were grouped by age, Figure 2 shows that the age group "below 30" (n = 29) mostly communicate face-to-face, via electronics and through telephone calls on a daily basis (aggregate of 53 %). Specifically, 31 % would *always* communicate face-to-face; twenty-nine percent would *always* communicate via electronics technology; 29 percent *always* preferred telephone calls and 11 percent would *always* use written communication technology.

Out of 26 respondents from the age group of "over 30", 28 % would *always* use written communication technology, 26 % would *always* use face-to-face, 24 % would *always* prefer written communications, and 22 % would *always* utilize telephone calls.

On the whole, face-to-face and electronic communications technology were the most popular forms of communications regardless of the age of the respondents.
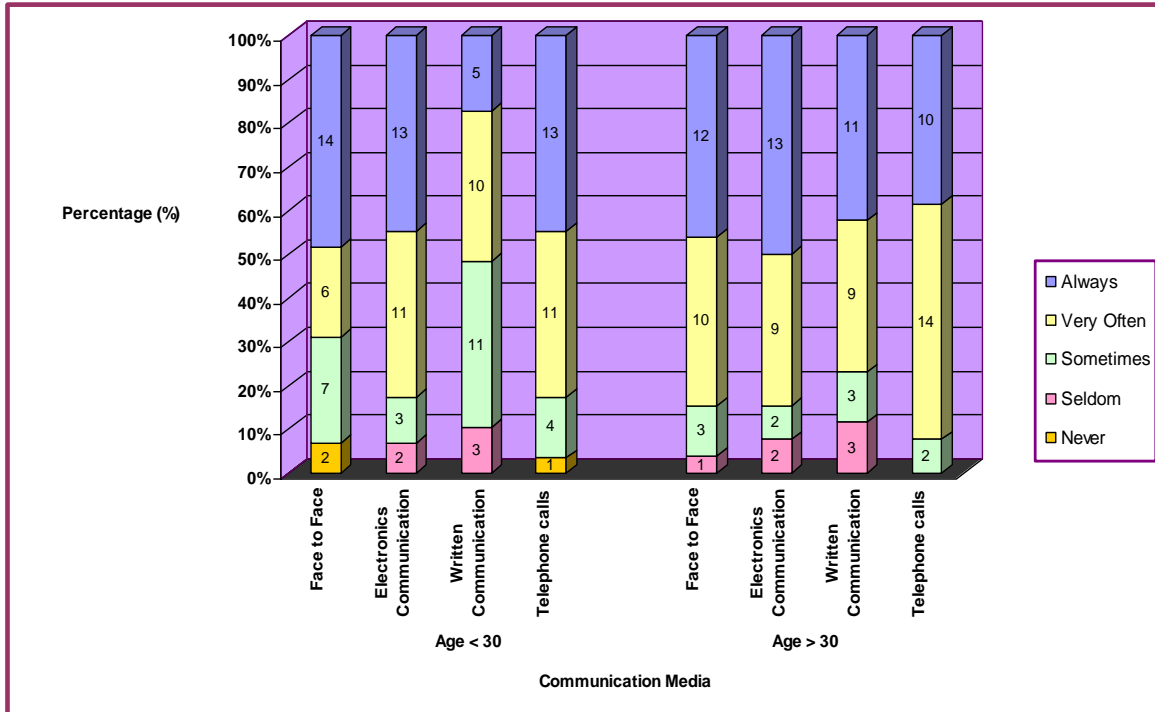

Fig. 2. Communication Technology Usage of Respondents by Age Group

In terms of the industry or sector, 30 (54.5 %) of them came from the manufacturing industry while 18 (32.8 %) were from services, 5 (9.1 %) from trading, and 2 (3.6 %) from logistics. Across all industries covered, face-to-face and electronics communication technology dominated the workplace as regards frequent usage. This scenario was more pronounced in the manufacturing sector than the rest of the industries covered in the study. Figure 3 presents the data.

As regards job function, Table 1 shows that in Research and Development (R&D), written communication and telephone calls dominated usage as mentioned by the respondents.

For Purchasing, electronic technology was the most preferred technology for communication, followed by face-to-face and the use of telephones.

For Finance, the use of telephones was *always* used, followed by electronic communication whereas for the Corporate/General Management functions, electronic technology and written communication became the most preferred mode of communications.
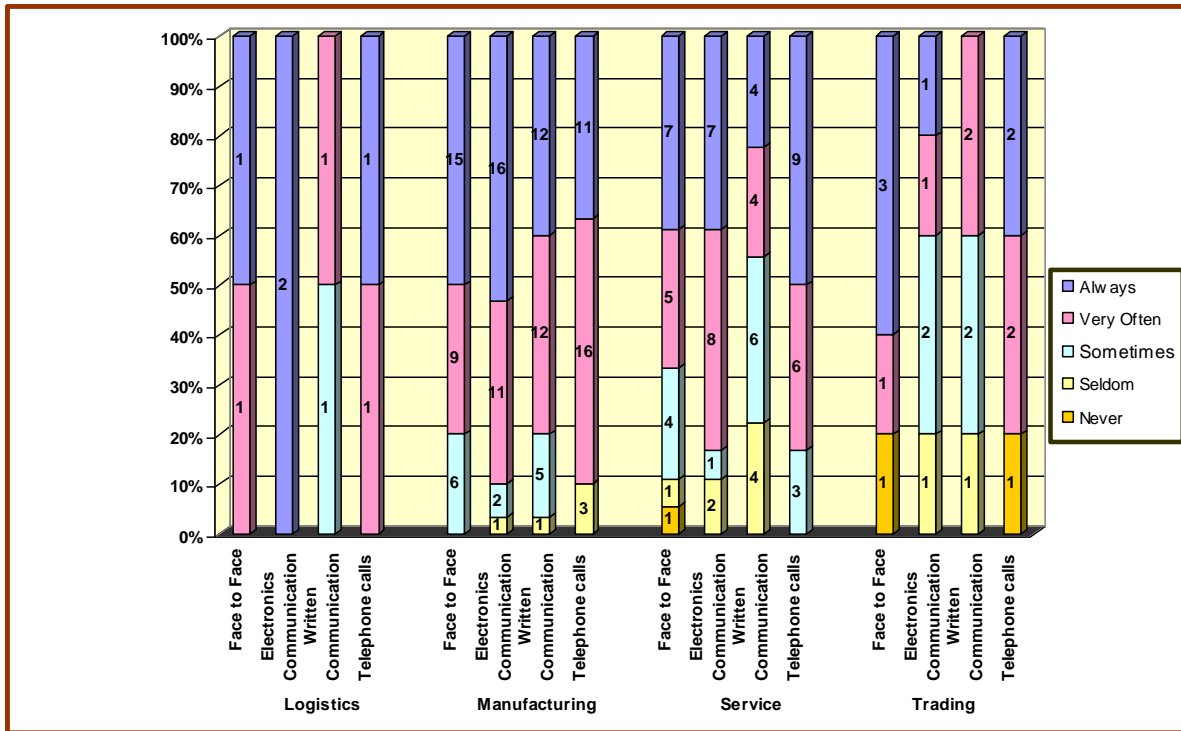
Fig. 3. Communication Technology Usage of Respondents by Industry

For Production/Manufacturing, face-to-face and electronic technology there were preferred modes of communication whereas for the Sales and Marketing, face-to-face communication was the most prevalent communication mode in action.

For Quality Assurance, face-to-face communication was *always* used whereas for the information technology (IT) functions, electronic communication was *always* preferred.

For the Services, making telephone calls was the most prevalent communication mode, followed by face-to-face and electronic communications.

Overall, the findings suggest that various communication technologies and modes of communication were used in a range of job functions across the industries involved in the research.

Effectiveness of Communication

By Age. As shown in Figure 4, 26 out of 29 respondents (89.7 %) whose age is under 30 mentioned that "email" and "co-workers" are either "effective" or "extremely effective". Meanwhile, only 23 (79.3 %) picked "manager"; 19 (65.5 %) chose "intranet" and 14 (48.3 %) picked "voice mail" as either "Effective" or "Extremely Effective".

For the group whose age is over 30, "manager" turned out to be the most "effective" or "extremely effective" as viewed by 24 out of 26 respondents (92.3 %). Another effective technology was the use of email (84.6 %) as well as the help of co-worker (76.9 %), intranet technology (69.2 %), and voice mail (46.2 %).

By Type of Industry. On the whole, Table 2 shows that a total of 49 out of 55 (89.1 %) respondents believed that the "manager" is either "effective" or "extremely effective" in the communication process at work. This was followed by "co-worker" (83.6 %), the use of electronic mails (80 %), intranet technology (78.2 %), and voice mail (47.3 %).

In the logistics industry, the use of intranet technology and support from co-workers were deemed "effective". This followed by "manager", electronic mail, and voice mail.

For the respondents who are in the manufacturing industry, those deemed "effective" were electronic mail (90 %), support from the manager (86.7 %), co-workers (83.3 %), intranet technology (76.7 %), and voice mail (46.7 %).

Table 1. Communication Technology Usage by Job Function

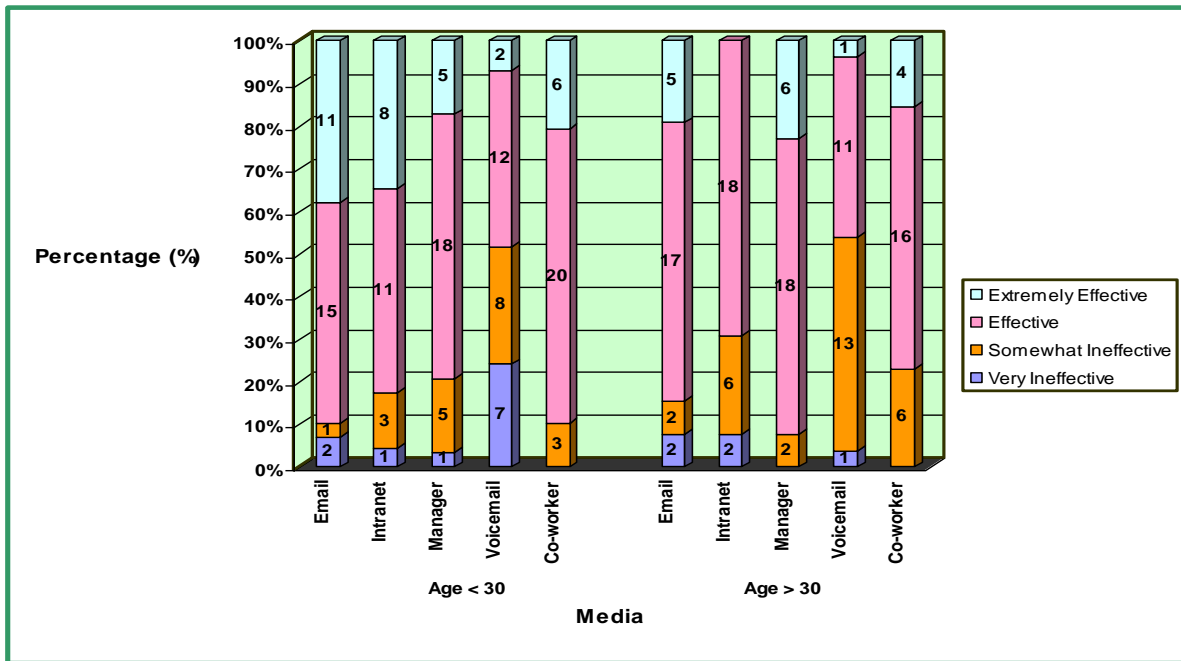| Job Function	Technology/Communication Mode	Never	Seldom	Sometimes	Very Often	Always
R&D (n = 9)	Face-to-Face	0	0	1	2	6
	Electronics Communication	0	0	0	4	5
	Written Communication	0	0	0	5	4
	Telephone calls	0	0	0	5	4
	Total:	0	0	1	16	19
Purchasing (n = 5)	Face-to-Face	0	0	1	1	3
	Electronics Communication	0	0	1	0	4
	Written Communication	0	0	2	1	2
	Telephone calls			1	1	3
	Total:	0	0	5	3	12
Finance (n = 6)	Face-to-Face	0	0	3	3	0
	Electronics Communication	0	0	0	4	2
	Written Communication	0	1	3	2	0
	Telephone calls	0	0	2	1	3
	Total:	0	1	8	10	5
General/ Corporate Management (n = 6)	Face-to-Face	0	1	1	2	2
	Electronics Communication	0	0	0	2	4
	Written Communication	0	0	0	2	4
	Telephone calls	0	0	0	3	3
	Total:	0	1	1	9	13
Production/ Manufacturing (n = 17)	Face-to-Face	1	0	1	7	8
	Electronics Communication	0	1	3	6	7
	Written Communication	0	3	5	4	5
	Telephone calls	1	0	2	10	4
	Total:	2	4	11	27	24
Sales & Marketing (n = 5)	Face-to-Face	0	0	0	1	4
	Electronics Communication	0	2	1	1	1
	Written Communication	0	1	2	2	0
	Telephone calls	0	0	0	3	2
	Total:	0	3	3	7	7
Quality Assurance (n = 2)	Face-to-Face	0	0	1	0	1
	Electronics Communication	0	0	0	2	0
	Written Communication	0	0	0	2	0
	Telephone calls	0	0	1	1	0
	Total:	0	0	2	5	1
IT (n = 2)	Face-to-Face	0	0	2	0	0
	Electronics Communication	0	0	0	0	2
	Written Communication	0	0	1	0	1
	Telephone calls	0		0	1	1
	Total:	0	0	3	1	4
Services (n = 3)	Face-to-Face	1	0	0	0	2
	Electronics Communication	0	1	0	1	1
	Written Communication	0	1	1	1	0
	Telephone calls	0	0	0	0	3
	Total:	1	2	1	2	6

Fig. 4. Effectiveness of Communication Technology by Respondents' Age

Table 2. Effectiveness of Communication Technology/Mode by Type of Industry

Type of Industry	Communication Technology/Mode	Very Ineffective	Somewhat Ineffective	Effective	Extremely Effective
Logistics	Email	1	0	1	0
	Intranet	0	0	2	0
	Manager	0	1	1	0
	Voicemail	1	0	1	0
	Co-worker	0	0	2	0
Manufacturing	Email	2	1	19	8
	Intranet	2	5	19	4
	Manager	0	4	17	9
	Voicemail	3	13	13	1
	Co-worker	0	5	18	7
Service	Email	1	1	8	8
	Intranet	1	4	12	1
	Manager	1	0	14	3
	Voicemail	2	6	8	2
	Co-worker	0	2	13	3
Trading	Email	0	1	4	0
	Intranet	0	0	5	0
	Manager	0	0	5	0
	Voicemail	2	2	1	0
	Co-worker	0	2	3	0

In the service industry, communication was viewed to be effective with the roles played by the managers (94.4 %), followed by the use of electronic mail (88.8 %), support from co-workers (72.2 %), the use of intranet technology, and voice mail (55.6 %). "Effective" communication viewed by respondents working in the trading industry were: the use of intranet and support from the manager, followed by electronic mail, support from co-workers, and the use of voice mail.

By Company Size. From the total of 55 respondents, Figure 5 shows that 6 (10.9 %) were from companies where the employees were less than 50; 10 (18.2 %) were from a company size of 51-150; 10 (18.2 %) from those with 151-500 employees; and 29 (52.7 %) were from companies with more than 500 employees.

As shown in Figure 5, 83.3 % of those who worked in companies with a size of less than chose "manager" as either "effective" or "extremely effective" facilitator of communication while 66.7 % chose electronic mail, intranet technology, and co-workers as either "effective" or "extremely effective" communication technologies or channel of communication. More than one-third (33.3 %) mentioned voice mail as "effective".

In companies with a size of 51-150, electronic mail is the most effective communication technology followed by "manager" and "co-worker", voice mail, and intranet.

Findings also showed that in companies with 151-500 employees, having supportive "co-workers" (9 out of 10 chose either "effective" or "extremely effective"), use of electronic mails (8 out of 10 chose either "effective" or "extremely effective"), and intranet technology (8 out of 10 chose either "effective" or "extremely effective"), having supportive "managers" (7 out of 10 chose either "effective" or "extremely effective"), and voice mail (3 out of 10 chose either "effective" or "extremely effective") would facilitate communication flow and processes in the workplace.
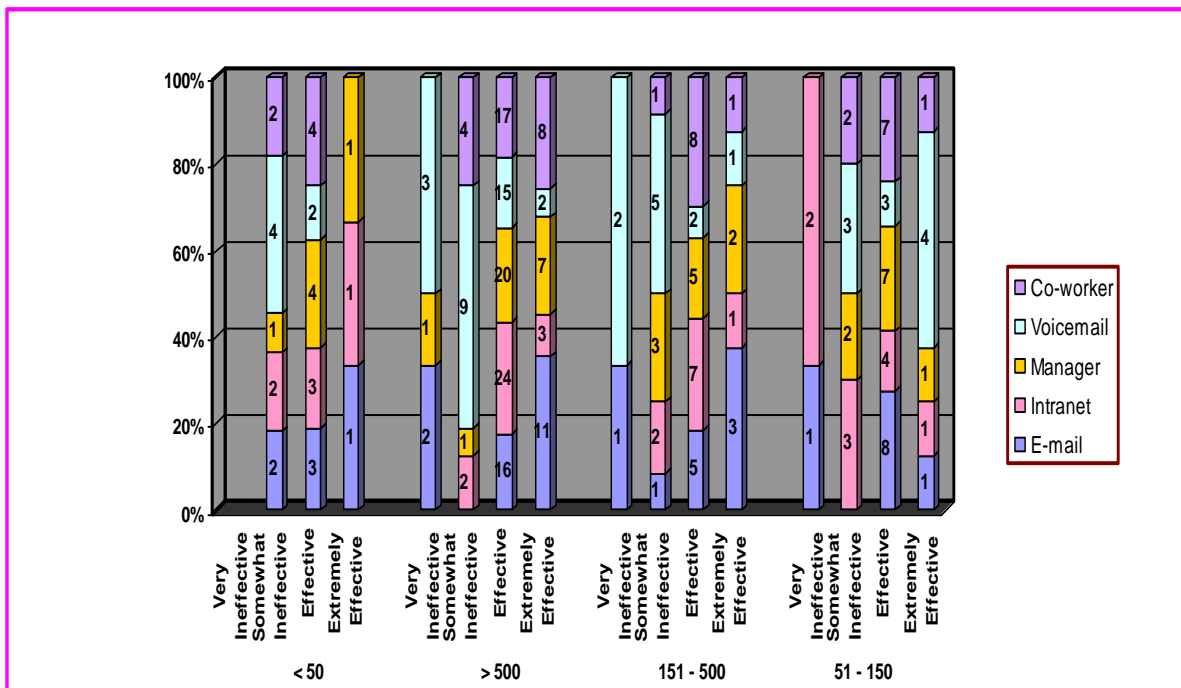

Fig. 5. Effectiveness of Communication Technology by Company Size

In large companies (more than 500 employees), a similar scenario was observed where the manager was seen as playing important roles in the communication process. The use of electronic mails and intranet technology (aggregate percentage of 93.1 % viewed the first three communication technologies and communication modes as either "effective" or "extremely effective") also had significant impact in communication. Moreover, it was shown that 86.2 % of the respondents viewed "co-worker" and voice mail (58.6 %) as either "effective" or "extremely effective".

5. Conclusion and Recommendations

The four industries covered in the research utilized a mix of communication technologies and communication modes in order to manage the communication flow in the workplace. In particular, electronic communications were of special attention owing to the roles of information and

communication technologies (ICTs) in contemporary management of organizations. Managers and co-workers were also viewed as critical in maintaining an atmosphere of effective communication.

Despite the mixed-mode scenario of communication technologies and communication modes, the respondents tended to prefer to use face-to-face and electronic communications more frequently compared to written communications and telephones. The findings also showed that electronic mails, co-workers and managers were much more effective compared to the use of intranet and voice mail.

It is suggested that companies should conduct training programs and workshops to strengthen the use of communication technologies and improve communication modes across the industries covered in the research. They also need to upgrade communication technologies at work to make them more attuned to organizational and employee needs.

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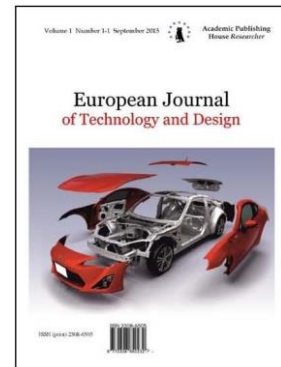
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**Analysis the Transient Process of Wind Power Resources
When there are Voltage Sags in Distribution Grid**

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Abstract

Vietnam has many advantages of wind power resources. Time by time there are more and more capacity as well as number of wind power project in Vietnam. Corresponding to the increase of wind power emitted into national grid, It is necessary to research and analyze in order to ensure the safety and reliability of win power connection.In national distribution grid, voltage sag occurs regularly, it can strongly influence on the operation of wind power. The most serious consequence is the disconnection. The paper presents the analysis of distribution grid's transient process when voltage is sagged. Base on the analysis, the solutions will be recommended to improve the reliability and effective operation of wind power resources.

Keywords: wind power, transition process, reliability.

1. Introduction

Wind power is renewable and green energy in Vietnam. According to accounting data, Vietnam has rich wind power capacity with 8,6 % area that is applicable to build up big wind power stations, among that 41 % area in urban area is suitable to build small stations. Total capacity of wind power is about 513.360 MW (Do Nhu Y, Le Xuan Thanh, 2016).

Voltage sag is a popular phenomenon in power system that makes wind power parameters changed. Therefore analyzing the transient of wind power sources at voltage sag moments, in order to recommend suitable operation for power system containing wind power, plays an important meaning.

2 Research method

Nowadays, most of wind power stations utilize Double-feed-Induction-Generator (DFIG) because they have the prior advantages when stator is directly connected to the grid whereas rotor is connected to the grid through controllable power electronic devices. Because the controller in rotor, therefore its power is much smaller than the power of generator; power flows directly from stator to grid, especially with big capacity generator. In the limit range of speed, the power of converter is only 30 % grid transmitting power. The structure of wind power generator DFIG is shown in figure 1 (Lai et al., 2010; Dami et al., 2010; Youcef Bekakra, Djilani Ben Attous, 2011).

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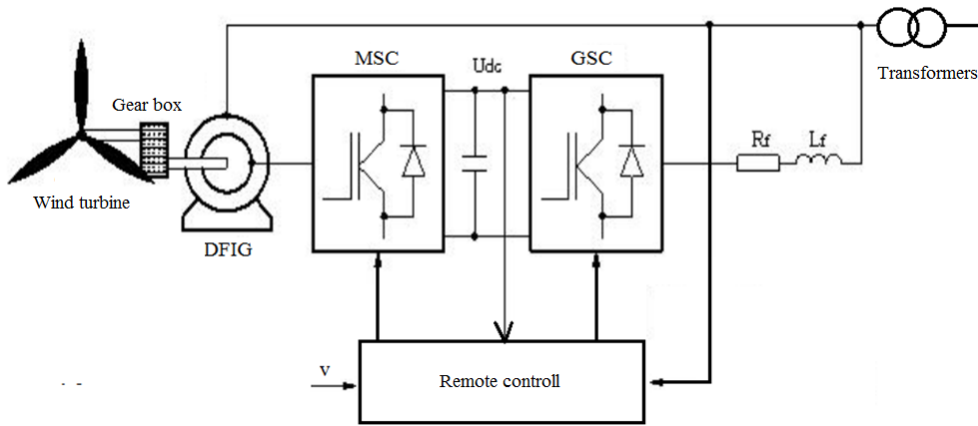E-mail addresses: donhuy@humg.edu.vn (Do Nhu Y)

Fig. 1. Structure of wind power DFIG

In figure 1 (MSC) is the converter on generator side used to control generator's speed in order to get maximum power. Input signals of speed controller is deducted from wind velocity. Output signals of speed controller is the ref signal for power loop controller. Grid source converter (GCS) controls DC voltage (U_{dc}). It is also used to control reactive power Q.

To analyze the transient occurred in wind power when there is voltage sag, power system is simulated on Matlab-Simulink. Power generator DFIG is simulated on dq axis as figure 2.
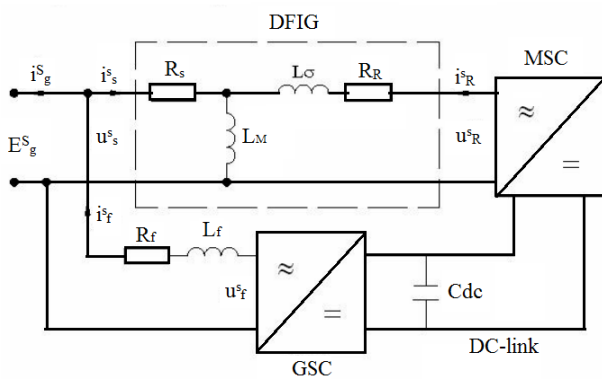
Fig. 2. Simulation of DFIG generator on space vectors

Replacing equivalent model of DIFG is expressed in stator's space vectors as shown in figure 3.
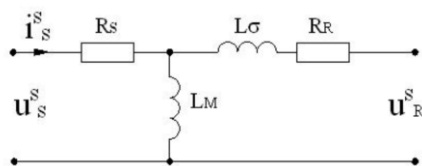

Fig. 3. Equivalent diagram of DFIG on space vector

Where: R_S – stator winding resistor; L_M – Magnetic induction; $L\sigma$ – Induction of stator and rotor converted into stator side; R_R – Rotor resistor converted to stator. Letter s means space vectors ref on stator of DFIG.

According to (Do Nhu Y, 2016; Doh, Chung, 2003; Cho, Lai, 2013), Kirchhoff equations for loop circuits:

$$u_S^s = R_S i_S^s + \frac{d\Psi_S^s}{dt}$$

$$u_R^s = R_R i_R^s + \frac{d\Psi_R^s}{dt} \tag{1}$$

The fields of stator, rotor, and electromagnetic torque are computed by the following equations:

$$\Psi_S^s = L_M \left(i_S^s + i_R^s \right)$$

$$\Psi_R^s = L_\sigma i_R^s + L_M \left(i_S^s + i_R^s \right) \tag{2}$$

$$T_e = 3Z_p I_m \left[\Psi_s i_R^* \right]$$

Where: L_M–Magnetizing induction; $L\sigma$ - Convert induction

$$L_S = gL_{sl} + \lambda^2 L_{rl}$$

$$\lambda = \frac{L_{sl} + L_M}{L_M} \tag{3}$$

Where: λ-Convert factor; L_{sl}; L_{rl}–Induction ofstator, rotor; Z_p– generator pole pair.
Mechanical equation of system is expressed by:

$$\frac{J}{Z_p} \frac{d\omega_r}{dt} = T_e - T_s \tag{4}$$

Where: J –Inertia torque; ω_r–rotor rotating velocity; T_e–electromagnetic torque; T– mechanic torque on rotor's shaft.

Maths expression of filter on grid side includes R_f and L_f, replace models is shown in figure 4.
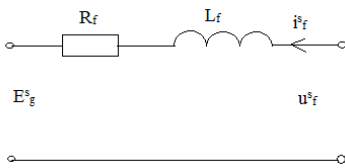

Fig. 4. Model of filter on grid side in space vector

According to (Do Nhu Y, 2016), Kirchhoff equation on dq axises:

$$E_g^s = -R_f i_f^s - L_f \frac{di_f^s}{dt} + u_f^s \tag{5}$$

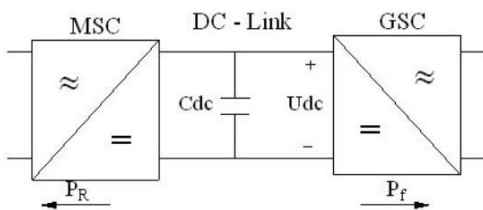Maths expression of DC – Link, replaced model is shown in figure 5.

Fig. 5. Model of DC – Link

Energy W_{dc} is deducted from capacitor C and is computed by the following equations:

$$W_{dc} = \frac{1}{2} C_{dc} U_{dc}^2$$

$$\frac{dW_{dc}}{dt} = \frac{1}{2} C_{dc} \frac{d}{dt} u_{dc}^2 = -P_f - P_r \tag{7}$$

$$C_{dc} u_{dc} \frac{d}{dt} u_{dc} = -P_f - P_r$$

Output power of wind generator is calculated by:

$$P_m = C_p(\lambda, \beta) \frac{\rho A}{2} v^3 \tag{8}$$

Where: P_m –Output power of wind turbine; $C_p(\lambda,\beta)$ –power conversion factor (ratio of wing velocity λ and wing angle β); A –cross section of; ρ - air density; v -wind velocity.

Power conversion factor Cpis determined as:

$$C_p(\lambda, \beta) = 0{,}5176 \left(\frac{116}{\lambda} - 0{,}4\beta - 5 \right) e^{\frac{21}{\lambda_i}} + 0{,}0068\lambda \tag{9}$$

$$\frac{1}{\lambda_i} = \frac{1}{\lambda + 0{,}08\beta} - \frac{0{,}035}{1 + \beta^3}$$

Ratio of wing velocity and wind velocity is determined by:

$$\lambda = \frac{R\omega}{v} \tag{10}$$

Where: ω- Turbine rotating velocity; R –Turbine radious

On other hand wind turbine can be operated by different controlling rules base on wind velocity. Figure 6 is the expression of relation between wind turbine's power and wind velocity.
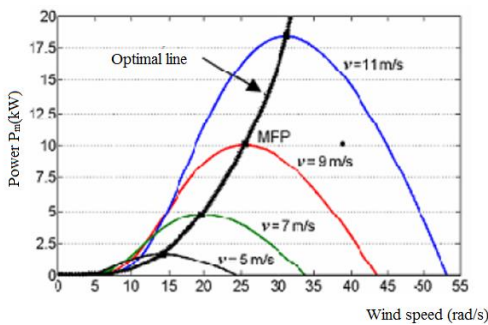

Fig. 6. The relation of wind turbine's power and wind velocity

Utilizing the simulation on Matlab-Simulink, above mentioned equations are expressed in figure 7 (Do Nhu Y, 2016).
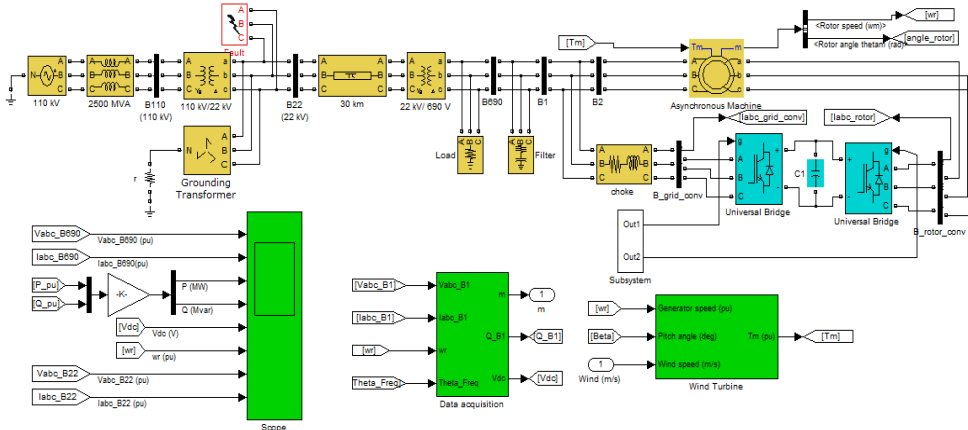

Fig. 7. Simulation diagram

3. Results

Simulation results are implemented on system with the following parameter: output voltage 690V, step-up transformer is 690V/22kV, the wind power system is connected with power system on 22kV bus bar. In the operation of the system, there is a voltage sag, consequently voltage on 22kV bus bar is reduced (as shown in figure 8 The transient process of output voltage of wind power is shown in figure 9, the current changing is presented in figure 10 and the transient velocity of motors is on Figure 11.
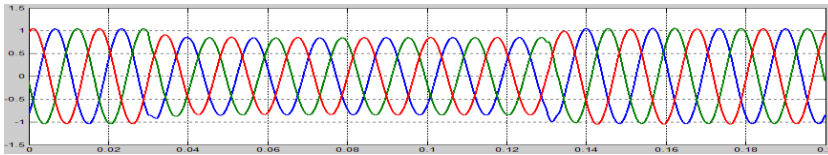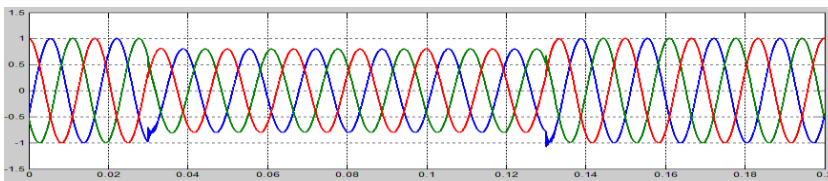

Fig. 8. Voltage on 22kV bus bar (B22)

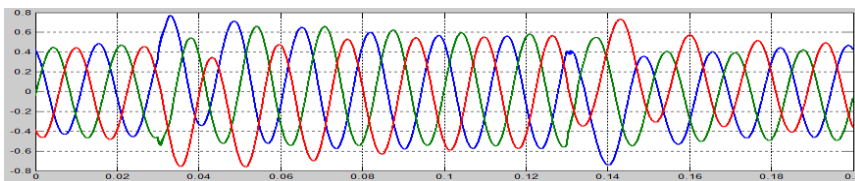**Fig. 9.** Response voltage of wind power

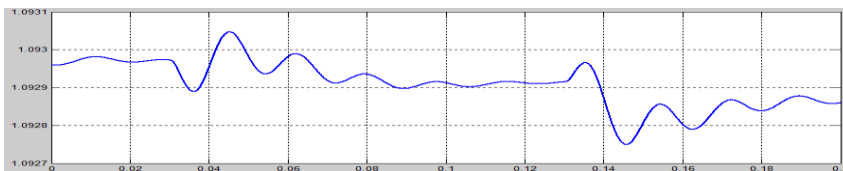**Fig. 10.** Response current of wind power

Fig. 11. The transient of generator velocity

4. Conclusion

The above simulations show that, when there is voltage sag on distribution grid (22kV bus bar) output voltage of generator is also down (fig. 9), consequently current of generator is increased (fig. 10). If the process is long lasting can cause over load or destroy the generator. At the moment of voltage recovery, wind power voltage is also recovered, but it is transient much over rated voltage. This cause to the transient of generator velocity (fig. 11).

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