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VOCATIONAL KNOWLEDGE TRANSFER OF CRAFT MASTER SKILLS IN POST-INDUSTRIAL ERA

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Abstract: Post-industrial era can be described as a time of transition from primarily manufacturing of physical goods to service economy, due to technological revolution conversion in the last decades of the 20th century. This decline from industrial manufacturing has led to higher unemployment and demise of traditional craft skills vocational training. Economies of developed world is confronted with the shortage of the skilled industrial trade, as well in qualified home trade service i.e. cabinetmakers, plumbers and electricians. Shrinking availability of trained crafts people requires implementation of more practical apprenticeship programs, ensuring these skills don't get lost. This paper points out the importance of mentoring in manufacturing, as well as for service companies and presents results of survey on mentoring in three medium-sized companies in Canada.
Keywords: craft trades, working with hands, skills knowledge transfer, apprenticeship programs, mentoring

1. INTRODUCTION

The impetus for the current research, and for this article, came from concerns expressed to the author by entrepreneurs about the apparent trajectory of diminishing availability of craft skill trades. Traditional crafts are still "in the hands of an ageing population" and time is running out to exploit their knowledge and experience. The world is aging and globally population aged over 60 is growing faster than any other generation. Skilled trades retiring is creating workforce gap which affects all manufacturing industries, and gloomily the existing apprentice training is not effectively bringing the young replacement. If this workforce gap is not addressed suitably, it might result in traditional know-how expertise and skills of craftspeople to vanish. According to the World Economic Forum, it points to new future trends where hands-on craft skill work might be less sought after, as the world will turn to new inventions of technology and automation. But at same time, life ergonomics require coordination of mind and movements. This "fame" of scientific and professional prophecy is illusory prediction from fact that human hands with practical work are always a necessity in all activities in life and hands-on professions [1]. Stereotype belief for years now has been that attending the apprentice training in vocational tech schools are young students who couldn't participate in "regular" school. This skilled trade gap in manufacturing requires more assertive education approach in making apprentice qualifications appealing to new generation to participate in "hands-on" crafts training programs. Amalgamation of theoretical learning at school with alternating practical work in industrial manufacturing facilities allows apprentices to develop practical knowledge and skills relevant to the labor market and employer needs. Apprentices through practical "hands-on" work are supervised by their mentors to learn craftsmanship by observation, imitation and practice. Skilled trade training initiatives should be aimed at providing training to teachers and mentors within companies. One of important aspects of skilled trade education in existing manufacturing plants is engagement of mentors, who are recognized by plant management as competent journeymen trained to work and guide apprentices. Another approach in passing on technical expertise and skills is to invite retired journeymen to return to the place of their previous employment and take role of "hand-on" mentoring apprentices. Acceptance of a journeyman to mentor other trade workers can be challenging because beside professional competence requires "soft skills" personal approach. Collaboration between mentor and apprentice can be beneficial, especially as reciprocal form of mentorship, where junior computer savvy employees teach senior journeymen and help them to learn skills to understand computerized information technology.

2. APPRENTICESHIP

— Brief History of Apprenticeship

Back in early history during the 18th century BCE in Egypt and Babylon, the Code of Hammurabi of Babylon rules for master craftsmen ratified how to ensure transfer of knowledge and skills to younger generation to safeguard continuation of quality of their trades. Initially during Roman Empire craftsmen were slaves, but eventually "collegia" associations similar to guilds were established to recognize and control craftsmen reputation. During Middle Ages by the 13th century in Western Europe craft guilds as trade association were established control the quality, methods of production, training of apprentices and work conditions. A master craftsman retained apprentices in their early teens as a free labor, but provided food, lodging and formal

training in the craft [2]. Apprenticeship and trades today are regulated by government educational authorities, trade unions and business organizations. The labor laws support "dual" character of the training system where the vocational part-time schools replace the traditional high schools. This "dual" type of training requires improving and better coordination between the school and the workplace. The new initiatives of involving internal with external mentors in companies can enrich the existing training programs. Continuous training to teachers and mentors at college level and within companies should be implemented by education authorities, by local chambers and augmented through government funding.

— **Craft Trade Labor Shortage**

Manufacturing is dealing with pending shortages of skilled-trade workers. According to EMSI (Economic Modeling Specialists International), age is an important factor in skilled trade shortage. Age break-down comparison between skilled trades and all jobs indicates that skilled trades are retiring earlier and replenishment with younger generation trades in manufacturing is becoming critical.

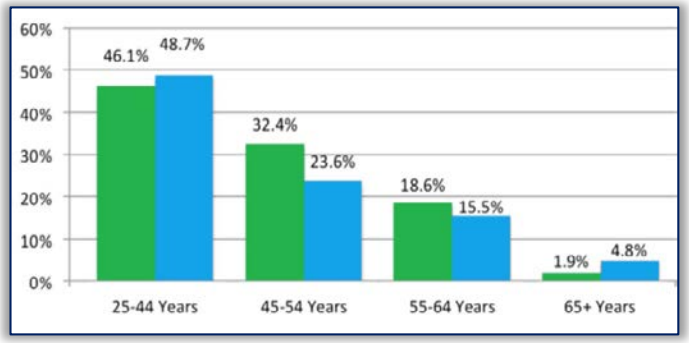


Figure 1. Age Breakdown: Skilled Trades vs. All Jobs [3]

According to the above breakdown skilled-trade workers keep working after the age of 65-far fewer than in other occupations. One reason is that skilled trades jobs are physically demanding, although, an opportunity should be created for skilled trade seniors to work as mentors upon retirement.

— **Craft Trade Apprenticeship**

Trade apprenticeship benefits the economy, individuals and companies. Collaboration of private sector with public authority benefits companies, apprentices and manufacturing economy. According to Encyclopedia Britannica apprenticeship is *training in an art, trade, or craft under a legal agreement that defines the duration and conditions of the relationship between master and apprentice* [2]. A skilled trade apprentice is trained under supervision of qualified journeyman on the job and also learn in a classroom from instructors who know the trade. In addition, a qualified mentor, who is usually experienced journeyman, can be assigned to an apprenticeship to lead him or her in acquiring work habits and trade skills. Phases of skilled trade training are outlined in three various stages of development: from apprentice to journeyman and to the final recognition as a master. Each segment of training and skills development is based on professional competence and technical knowledge as described in table 1.

Table 1. Phases of Skilled Trade Training. Source: [4]

Apprentice	Journeyman	Master
In-process of Improving Technical Expertise (Learning elementary trade skills)	Competent Technical Expertise (Proves ability to complete tasks working as a team, but recognizing his/her own trade skills limitations}	Mastered Technical Expertise (reached recognition by authorities and other masters to share expertise as a mentor and instructor)
Primary Professional Competencies (Works under supervised instruction to correct and improve on making mistakes)	Ability to complete tasks with Professional Competencies (reached professional growth to teach, mentor and supervise others)	Demonstrates Professional Competence (co-operates and interacts with other masters to develop technical applications and leads others to improve performance)

Apprenticeship training has similarities with Canadian, German or Swiss programs in collaboration of companies, educational institutions and government that is known as Triple Helix model in economic development. In order to participate in apprenticeship training programs, companies have to be assessed to prove the existence of appropriate trade manufacturing facility and employs qualified in-company trainers and mentors. Business training plan has to be prepared and approved to gain approval for government funding under Department of Labor umbrella. There is cost in hiring and training apprentices, for which is usually assistance available in the form of government grants and incentives for companies taking on apprentices [5]. Journeyman mentor, besides being proficient in trade, must have ability to teach and transfer knowledge to an apprentice. Approval of a journeyman to become a mentor to other trade workers can be challenging, because beside professional competence requires "soft skills" in personal approach toward apprentices. These "soft skills" are also important to throughout progression path of apprentice-journeyman-master in learning to higher level of competences and ultimately expand on effective networking with professional acquaintances. This network of passionate trade associates can later in life create a cluster of entrepreneurs to join together in business cooperatives. In-company apprenticeship training differs worldwide based on,

governance, employer cost-sharing, recruitment procedures and support structures to maintain the right balance in all stakeholders' interest. Most countries share costs of apprenticeships programs between government incentives, employers, trade associations and unions. In some countries apprentices are hired as regular employees or are employed as part time students. Principal difference relates to contractual agreement where companies treat apprentice training as an investment with their commitment to stay on working for certain period of time upon graduation. It is important to for companies to participate in apprenticeships programs as an effective means of recruitment, which eventually produce a pool of skilled trade journeymen and allows market sharing of trained resources. This pool of trade skill graduates stream is in the interest of manufacturing economy and nourishing labor market.

— Enticement for manufacturers to be involved in apprenticeship programs

Manufacturers empowering employees is important element of company sustainability and reputation. Investment in building competence of employees in training and apprenticeships benefits the economy, individuals and companies.

As an add-on to the above chart there are other motives for manufacturing companies' decision to be involved in apprenticeships:

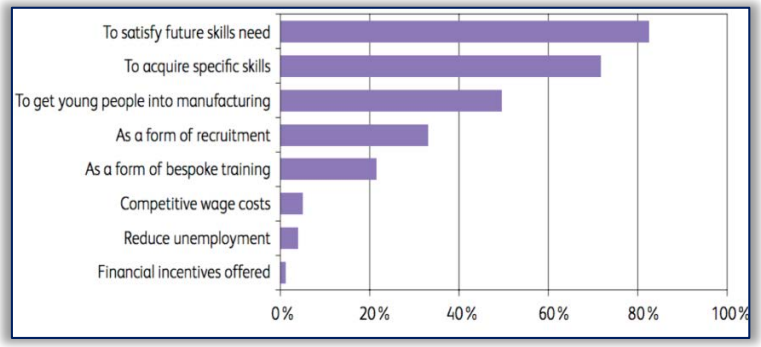


Figure 2. Reason why manufacturers offer apprenticeship [6]

- An important reason for companies to engage in training is to secure a skilled workforce in future.
- Technological improvement in manufacturing sector forces companies to invest in latest equipment and apprentices are exposed to the most advanced state of the art technology. In comparison school training facilities mostly operate with existing equipment.
- The advantage of Dual System apprenticeship at school improves knowledge of science, technology, and mathematics.
- Apprentice time of learning at school expands IT-related skills and competences.

Education Endowment Foundation (EEF) reports lack of qualified skilled trades and advocates the government to launch new programs for apprenticeships and reform the education system to fill the gap of trade people leaving for retirement [7].

— Trades Apprenticeship Ending Note

In conclusions, the performance of a successful apprenticeship program depends on key elements, such as type of dual apprenticeship system, teachers, in-company trainers or mentors, approved training facilities, governance, stakeholder's cost-sharing, legal contract arrangements and recruitment procedures. The right balance between these elements and the diversity of education programs require adjustment according to labor market situations. Another challenge is to change the skewed perception of the trades as an inferior type of vocation and recognize trades an attractive profession [8].

3. THE ROLE OF LEADERS & MENTORS IN APPRENTICESHIP TRAINING

Leaders & mentors have important role in economic development while working, as well as when continuing mentoring as volunteers during active retirement. Correlation of mentors in skilled trade training programs emphasizes the importance of a relationship between mentor and protégé and explores developments of mentoring models. Successful mentoring is a relationship between mentor and protégé where both partners accomplish mutual correlational benefits.

— Brief History of Mentorship

The conception of mentoring originated in ancient Greece, when Odysseus entrusted his friend Mentor to teach and protect his son Telemachus [9]. Since then mentoring models have evolved to have a significant impact on knowledge transfer and professional development. The evolution of economy from feudalism into industrialization changed ways of communication and accelerated knowledge transfer. The new wave of information revolution known as Computer or Digital Age is as important as Gutenberg's invention of mechanical movable type printing press in the fifteenth century. IT technology is making an impact on all generations. The latest era of computerization has revolutionized sharing of knowledge through instant retrieval of information and evolution of mass media communication. Millennials embraced computers and it opened new opportunities for the techno-logically savvy younger generation to advance through hierarchal organizational structure.

Reverse mentoring emerged as an open-minded mentoring model, where IT competent younger gene-ration leaders contribute to relationship through reversed mentoring of older generation executives. The further advancement through natural development of mentoring relationship is a transition from a reverse model into a reciprocal one. Intergenerational knowledge transfer supports entrepreneurial strive to improve employee retention, excel in innovations and competitiveness, therefore increase enterprise's market share, and contribute to the accelerated economic growth.

— Development of reciprocal mentoring as a collaborative model

Recognition of mentoring is on the rise since the late 1980s. Importance of mentoring excelled since Kram's influential work [10] [11]. Mentoring relationships are recognized as one of the most effective way of transferring knowledge and experience in inspiring development of new leaders and *opportunity to interact one-on one with members of senior management helps newer employees develop a more sophisticated and strategic perspective on the organization* [1]. Theoretical research about positive benefits of mentoring has been researched in books, journal articles and research papers [12]. Traditional hierarchical mentoring model encompasses accomplished leaders as mentors to junior level employees. Rapid technological advances and generational diversity is transforming typical employee relationships. Reverse type mentoring is another model, where junior computer savvy employees mentor their senior managers and help them to learn skills to understand compute-rized information technology. This direct exposure of lower level employees to senior leaders led to reciprocal mentoring model as a two-way relationship for the benefits of both sides, especially beneficial to juniors in better understanding of the business operation [2]. Continuous extensive research created major advances in developing new mentoring models, which are implemented in entrepreneurial organizations and education institutions. Research papers, journal articles and books discuss positive benefits of mentoring [3]. In traditional hierarchical mentoring model accomplished leaders are mentors to junior level employees. This one-way mentoring model is mostly beneficial to protégé [13]. The reciprocal model of mentoring progressed from reverse model and it has been recognized in research literature on development of knowledge transfer; *mentoring has a dual focus on the leadership development of both mentor and mentee. Millennial mentors have the opportunity to demonstrate capabilities as leaders through their coordination of tasks and goals in this relationship.* [14] Rapid technological advances and generational diversity are transforming typical employee relationships. Developmental relationships are becoming one of the most important tools in cultivate new leaders [15]. Today multiple generations from aging boomers to young millennial are working side-by-side. Senior managers and aging mentors are challenged to become acquainted with new IT computerized technology. Computer savvy younger employees and senior management have mutual interest in learning from each other through reciprocal model of collaboration of knowledge exchange. Reciprocal mentoring is a two-way mutually beneficial correlation and gives opportunity to both participants to share knowledge and improve their competency [16].

— Mentorship in Craft Trades

Mentorship take important role in entrepreneurial learning, as well as in the context of trade skills multigenerational knowledge transfer in craft trades. In order to explore mentorship development this paper compares different mentoring models and how reciprocal model changes correlation benefits for an apprentice and senior mentor in craft skills training programs. Theoretical overview of two-way reciprocal mentoring relationship and correlation benefit findings in this paper confirm the hypotheses of positive overall effects on employees and to the overall prosperity of the company. Multigene-rational knowledge transfer models have variations in manufacturing, other industrial enterprises, government, academia and education.

— Data collection, measuring and analysis

Scientific contribution of this research presents alternative correlation benefit analysis of cross-generational mentor/protégé model in reciprocal mentoring, as well as attitudes following completion of mentoring programs. Three distinct different companies are analyzed to explore conceptual under-standing of entrepreneurial learning through mentoring process. The research has evolved from my own experience as an entrepreneur and as an executive being involved in managing and developing new engineering and craft skills talents for SME companies in Canada. The research survey emphasis value of reciprocal mentoring model and which are benefits to individuals and organization. Case studies in this research indicate that reciprocal mentorship is naturally occurring in small and medium size companies, as in large companies is engineered and is part of human resources training policy. Research in this paper corroborate evidence that reciprocal mentoring model brings further correlation benefits to individuals, improves employee retention, as well as enhanced performance of the entire organization. The findings in this research should encourage executives, entrepreneurs and human resources managers to implement reciprocal mentoring model and conceptualize it as an important initiative. The research framework developed is based on observations, narrative exchange,

interviews and qualitative methodology with corroborative analysis of data collected. Data used for employee retention is sourced from available human resource records for each company. The paper research studied employee satisfaction feedback on how reciprocal mentoring changed attitudes, level of competence, change of inner-company communication and variations in level of employee retention. Therefore, to analyze qualitative results, it was the most practical to use semi-structured confidential narrative exchange and voluntary interviews based on pre-determined set of open questions. Reciprocal mentoring satisfaction questionnaire results are expressed in percentage of positive or negative change, such as: (a) employee relationship, (b) multi-generational collaboration, (c) employee attitudes, (d) supervisor/subordinate collaboration performance, (e) job satisfaction, (f) company meeting expectations, (g) employee retention (2 categories), (h) enhancement leadership skills, and (i) - motivation to continue further education and training. Employee retention is one of the indicators of employee job satisfaction and survey questionnaire distinguishes two types of possible answers that suggest employee commitment to stay with a company. An employee has a choice to choose one of the answers. The first choice of answer is weather employee is currently searching for another employment elsewhere or employee is committed to stay with company.

— **Measuring Employee Retention Rate**

Employee retention rate indicates employee fluctuation and capacity of an organization to retain its employees. Employee retention rate can be calculated as follows: Total number of employees in the company number of employees minus number of employees who left the company divided by total number of employee and express as a percentage [15].

$$\text{Retention Rate \%} = \frac{(\text{Total number of employees} - \text{Employees that left})}{\text{Total number of employees}} \times 100$$

Retention rate number is the company personnel stability indicator and is usually calculated for a period of one year. This number does not include fluctuation of number of employees that left and joined company within the same time period. Turnover rate can influence and compliment retention rate and is calculated by number of employees left divided by the average number of company employees during the same time period [17].

— **Employee participant's survey**

The size of three firms has analyzed in this paper employ approximately 30 to 40 employees.

- Company #1 - is specialized in consulting engineering and fabrication.
- Company #2 - is in precision machining/manufacturing.
- Company #3 - is specialized in heating and ventilation equipment installation and service.

In the field of demography generations in the study are defined by the year of birth and are further divided in two groups based on work job category and management position.

1) Age/Work Experience Groups: (a) Traditional Mentors Group born 1946 -1976 and (b) Digitally Savvy Junior Mentors Group - born 1977- 2000

In the field of job category employees are classified in three groups:

2) Job Classification Groups: (a) Manager/Engineer, (b) Skill Trade Employee, (c) Apprentice

Questionnaire form for participants of the reciprocal mentoring program is created based on descript-tion of Employee Participants Survey. Results of survey are compiled in Table 2 - 4.

Table 2. Comparison Employee Retention Rate

Employee Retention Rate	Company 1	Company 2	Company 3
Before Reciprocal Mentoring Program	40%	50%	57%
After Six Months of Program implementation	55%	59%	56%

* Employees were expected to mark response on a 5-point scale where 1 is completely unsatisfied and 5 is very satisfied.

** The scores are calculated as average, based on replies of employees of all three companies analyzed.

*** Changes in Retention Rate comparison is calculated before implementation and after of six months of the program.

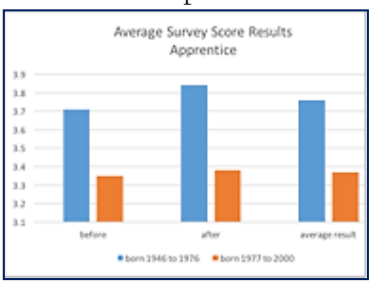
The data collected before and after the reciprocal mentoring program for each job classification is entered into tables and charts below. The results show positive significance of reciprocal mentoring implementation. Older apprentices born from 1946 to 1976 have been rehired through government program of requalification of people whose work place became redundant. All three companies have implemented apprentice program for training and requalification of older employees, who were forced to change their vocation for a new job. In Table 3 the score comparison is recorded before implementation of mentoring program and after completion of program. The answers in employee survey rating show consistent improvement in all areas, except in answers to question for managers/engineers about opportunity for career advancement and also for skilled trade motivation to pursue education and training. The rating of the opportunity to career change for managers/engineers stayed the same and explanation might be that older employees did not feel motivated to change or advance in their career. An explanation for lack of motivation to continue further training for older

age skilled trade was that their qualification reached the top. The most positive attitude changes have been recorded for managers/engineers feeling that company achieves their expectation and also that leadership skills improved following the mentoring program. The most positive attitude improvement for skilled trades has been recorded in supervisor/ subordinate collaboration, as well as improvement in leadership skills. In Tables 3 score comparison is recorded before implementation of mentoring program and after completion of program. The most positive attitude changes have been recorded for managers/ engineers in supervisor/subordinate collaboration, improvement in leadership skills, motivation to pursue further education and recognition that overall work environment improved. Skilled trades indicated the most improvements in multi-generational collaboration, job satisfaction, desire to pursue further training, opportunity for career advancement and overall recognition that company achieved their expectation. Following mentoring program apprentices show most of attitude improvement in supervisor/subordinate collaboration and desire to continue further education and training. In Table 5 the average success score of the mentoring program for all participants is recorded before implementation and after completion of the program. The average success rating show consistent improvement in all areas of employee attitudes - Graphs 3, Graph 4 and Graph 5.

Graph 3

Graph 4

Graph 5



(Source: Author research results for three companies)

Table 3. Data collected for 'A' participant (ages born from 1946 to 1976) and 'B' (born 1946 to 1976)

'A' = Age: born 1946 to 1976 'B' = Age: born 1977 to 2000		Average Scores											
		Before		After		Before		After		Before		After	
		A	B	A	B	A	B	A	B	A	B	A	B
Questions													
1	Team morale	4	4.1	4.3	4.3	3.5	3.2	3.7	3.7	3.7	3.5	3.8	3.7
2	Multi-generational collaboration	3	3.1	4	4.1	3.7	3.3	3.9	3.6	3.8	3.7	3.9	3.9
3	Supervisor/Subordinate collaboration	3.5	3.6	4	3.9	3.2	3.6	3.9	3.7	3.5	3.3	3.7	3.7
4	Job satisfaction	3.9	3.7	4.2	3.9	3.9	3.3	4.1	3.9	4.1	4	4.3	4.3
5	The company achieves my expectations	3	2.9	3.7	3	2.9	2.5	3.1	2.9	3.1	2.6	3.2	2.9
6	Opportunity for career advancement	4	3	4	3.1	2.5	2.6	2.6	2.9	2.5	2.6	2.6	2.7
7	I am committed to stay with the company	4	2.5	4.2	2.8	3.1	3.5	3.4	3.7	4.5	3.9	4.6	4.1
8	My level of leadership skills	4	2.5	4.7	2.9	3.3	2.5	4	2.7	3.5	2	3.7	2.2
9	I am motivated to additional training	3	3.5	3.2	4.1	4	3.3	4	3.7	4.6	4	4.6	4.5
10	Overall work environment	4	3.9	4.1	4.3	3.6	3.3	3.8	3.5	3.9	3.7	4	3.9

Source: Author research results for three companies

* Employees were expected to mark their response on a 5-point scale where 1 is completely unsatisfied and 5 is very satisfied.
** The scores are calculated as average, based on replies of employees of all three companies analyzed.

Table 4. Average reciprocal mentoring survey success results for all participants

	Manager/Engineer			Skills Trade			Apprentice		
Age	Before	After	Average	Before	After	Average	Before	After	Average
Born 1946 to 1976	3.24	4.04	3.62	3.37	3.72	3.55	3.71	3.84	3.76
Born 1977 to 2000	3.64	4.04	3.84	3.37	3.62	3.49	3.35	3.38	3.37

Source: Author research results for three companies

— Mentorship Ending Note

Most research articles with this topic are in field of academic education and virtual knowledge exchange. Theoretical research overview of multigenerational interactions in two-way reciprocal mentoring model is found to be relatively scares in corporate environment. Reciprocal mentoring implementation in corporate multigenerational environment is presented in this paper as alternative to traditional mentoring models. Contribution of this paper is to validate importance of corporate program in reciprocal mentoring. In this article, as well as other research papers confirm that reciprocal mentoring model is an improvement to conventional models, promotes closer co-operation between employees and creates collaborative benefits to both mentor and protégé. The paper contains brief review of literature in areas of mentoring and entrepreneurial learning. One of benefits of reciprocal mentoring is increase in company innovation capability,

as stated in study conducted by Lin [18]. Research papers about mentoring explored reciprocal relationship changes from face-to-face context to online knowledge exchange. *This opens up many possibilities for the development of collaborative reciprocal mentorships on an international scale* [19]. *Global managers engage in reciprocal learning processes to obtain new, innovative knowledge about other countries' environments and business practices* [20]. Recently a new research defined wider application of reciprocal mentoring, as omnidirectional relationship. *In many ways, suggesting that mentoring relationships can be reciprocal relationships where all parties have equal knowledge and expertise to gain and share* [21] Thematic discourse analysis in this paper *Correlation Benefits in Mentoring Relationship* is used to examine mentoring of three entrepreneurial companies in industrial service field. Material in study measures success of learning experiences and is used to develop a conceptual model of mentoring performance analysis and measure accomplishments in employee relationship. Findings based on data analysis have shown that participation of professionals, skilled trades and different ages have positive correlation influence on outcome of formal reciprocal mentoring programs. Attitude of older group of employees show minor or no improvement following complete-ons of formal mentoring program. In general, the findings confirm hypotheses that formal reciprocal mentoring program can be mutually beneficial to all involved and have positive overall correlation effects in employee attitude and company prosperity. Scientific theoretical research of multi-generational knowledge transfer models and overview of reciprocal mentoring suggests how important is to continue further development of the model.

4. CONCLUSIONS

Manufacturing economy is facing serious challenges with diminishing skilled labor force due to retiring, industrial plants being moved offshore and critical shortage of trade skill graduates creating craft skills workforce gap. Retiring senior journeymen capable and qualified in knowledge transfer of traditional crafts skills should be reactivated to mentor and train apprentices. According to the World Economic Forum, it points to the new future trends in where hands-on craft skill work might be less sought after, because the world will turn to new inventions of technology and automation. But at the same time, the life ergonomics require movement coordination between mind and body and must not be neglected. This "fame" of scientific and professional prophecy is illusory prediction from the fact that human hands with practical work are always a necessity in all activities in life and especially in hands-on professions. A greater emphasis on apprenticeship training programs is required with promotion of trades an attractive profession, not an inferior type of vocation. Working with hands and making tangible products is a professional quality to be respected and craft skills will always be required and especially stay in demand for industrial services and maintenance.

Note:
This paper is based on the paper presented at IIZS 2020 – The X International Conference on Industrial Engineering and Environmental Protection, organized by Technical Faculty "Mihajlo Pupin" Zrenjanin, University of Novi Sad, in Zrenjanin, SERBIA, in 08–09 October, 2020

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